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MACHINERY

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Abstracts of Principal Articles

Machining Blades for Gas Turbine Units P. 1082

In this article, which is the first of a series concerned with the activities of the B.R.D. Co., Ltd., brief reference is made to the history of the company and its present constitution, and the machining of precision forged compressor blades is then considered. These blades are forged from aluminium or steel alloy, by the suppliers, to the size required, within limits of ± 0·002 in. on the aerofoil portion, which requires no subsequent machining apart from light polishing. After the leading and trailing edges of the aerofoil have been milled, to provide location surfaces, on a special machine designed by the company, the blades are passed to two other milling machines on which the root ends are machined on three sides. Grinding of the serrations, whereby the blade is retained in position in service, is then carried out on one of three different types of machine, two of which are here described. The blades are held in box fixtures with standardized outside dimensions, which will suit all three types of machine, so that shop loading determines which is to be used for a particular blade. The ends of the root portions are also ground at an oblique angle, on the same machines, and the blades are then transferred to another special machine, on which the leading and trailing edges are polished and blended with the aerofoil surfaces. After the aerofoil and adjacent platform surfaces on the root end have been hand polished, the end of the aerofoil portion is cut off to give the specified length. Inspection and heat-treatment complete the series of operations on precision-forged blades. (MACHINERY, 92—9/5/58.)

Special-purpose Measuring Equipment for Gas Turbine Components.....P. 1095

Special-purpose measuring equipment recently developed by D. Napier & Son, Ltd., Acton, London, W.3, in connection with their programme of gas turbine development and production, includes a dial gauge angle-comparator, and a device for checking internal gears. Intended for inspecting blade attachment slots in stator rings, the angle comparator reads directly to 1 min., and is readily convertible for checking slots inclined in either direction. Zero setting of the instrument is effected with the aid of angle gauge blocks. The equipment for checking internal gears also incorporates a dial gauge, reading to 0·001 in., for rapid preliminary checking, and provision is made for recording on smoked glass. Such records are used for more detailed investigations, by projecting them at a magnification of 25 ×, on an optical projector. (MACHINERY, 92—9/5/58.)

The Production of Stub-Axle Assemblies for Volvo Cars .....P. 1098

An earlier article in MACHINERY, 92/700—28/3/58, described some of the methods employed by A.-B. Bolinder-Munktell, Eskilstuna, Sweden, for producing "front-end" components for cars, large vehicles, and buses, on behalf of A.-B. Volvo, Gothenburg, with whom they are associated. In this second article, some further operations on the stub-axles and support fittings, for the Volvo type PV-444/45 car, are considered. A Schaudt machine, equipped for automatic sizing, is employed for grinding the shaft portion of the stub-axle, and the shaft root radius is subsequently polished with a special cork/grit composition wheel, on a cylindrical grinding machine. Holes in the support fitting are drilled and reamed on a special-purpose Hüller multi-spindle machine, and the king-pin bore is finished to close limits on another multi-spindle machine. Tapping, by a method that eliminates the need for a tapping attachment, is performed on a 3-spindle Herbert drill. A differential type of dial comparator, developed by the company, is employed to facilitate the selection of shims of three different thicknesses, used in various combinations at the assembly stage. (MACHINERY, 92—9/5/58.)

Machining Operations on Alignment Telescope Barrels .....P. 1105

Barrels for the alignment telescopes made by Keuffel & Esser Co., U.S.A., are finish machined and inspected in air-conditioned areas of the company's Special Devices Department. The 9-in. plated section of the barrel must be cylindrical, free from taper and out-of-roundness, within 0·0001 in. Barrels are made from high-grade alloy tool steel, in the form of trepanned bar stock. After both ends have been turned, the barrel is stress-relieved. Next, the bore is machined on a Monarch lathe, with Bondycop profile-turning equipment, in two stages. Subsequently, the outside is turned and undercut in readiness for grinding. After holes have been drilled, a boss is silver-soldered over three knob holes, the soldering operation forming part of the heat-treatment cycle. Grinding follows, and for the final stage the barrel is mounted on an arbor and ground externally to within 0·0001 in., before it is plated. Unplated surfaces are Parco Lubrize treated. (MACHINERY, 92—9/5/58.)

Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

IN FORTHCOMING ISSUES

The production of automatic transmissions for motor cars—The production of shell-moulded crankshafts—Machining bearing housings on Monforts chucking automatics.

Developments in Plastics Tooling

The relative ease, economy, and rapidity with which metal-forming tools for a variety of purposes may be made wholly or partially from plastics materials has been well established for a considerable period. During recent years, much important development work has been carried out with a view to providing tooling plastics with improved properties, and introducing better methods of reinforcement and tool construction. As a result of these investigations, it has been possible, in many instances, to obtain considerably greater life from tools which are subjected to fairly severe conditions in service, also to extend the field of plastics tools to embrace certain applications for which they would formerly have been considered unsuitable.

Filling materials may have a considerable influence on the properties and performance of plastics tools, and many have been adopted with good results, including, of course, metal powders and glass fibres. It is now reported that very satisfactory tool life is being obtained from epoxy resin reinforced with steel fibre, which may be used alone or in combination with glass fibre. For some purposes, where heat conductivity is of importance, aluminium fibre has also been used, and tools made with this type of reinforcement have included heated matched moulds, vacuum-forming moulds, slush-moulding dies, and foundry patterns.

As an indication of the potentialities of the epoxy resin and steel fibre combination, it is stated that a tool, largely of this composition, has already produced more than 130,000 tank tops for motor-car radiators and is still in operation. The material is 0·025-in. thick brass, and the depth of draw, 3 in. Another tool, for producing refrigerator bottom panels from 0·035-in. cold-rolled steel, incorporates large inserts of the reinforced plastics for forming a cavity in the stamping. It has been estimated that ten weeks would have been required to make a conventional steel tool for this operation, whereas the composite tool was available within five weeks from the date or the order, and has so far formed 65,000 panels, without requiring any repairs.

Evidence of the very substantial saving that can be obtained by adopting this tool material is afforded by the fact that, in one instance, 35 metal fibre reinforced tools were made in 15 weeks, at a cost of 250,000 dollars. On this basis of a careful estimate, it is asserted that metal tools would have cost about eight times as much, and that their production would have occupied 18 months.

Fibres for reinforcement are produced by the normal metal wool process, and the shavings are usually of triangular cross section with sharp corners. Fine grades enable mixtures of low porosity and even distribution to be obtained, but with somewhat coarser grades slightly better physical properties can be obtained. According to Mr. A. P. Mazzucchelli, who spoke at a recent meeting of the Reinforced Plastics Division of the Society of the Plastics Industry in the U.S.A., the procedure for making tools with metal fibre differs in several respects from the normal casting processes. A fairly thin facing coat of heat-resistant epoxy resin is first applied to the mould surface, and this layer is then flocked with short steel fibres, either by means of a spray gun or with a specially-designed flocking unit. Next, a weighed charge of resin is poured into the cavity, followed by a weighed charge of dry steel fibre which should form 55 to 60 per cent of the whole. Pressure is applied to the fibre mass by means of a hardwood plug, so that it is forced slowly down, while the resin flows up between the fibres, and excess escapes through vent holes in the plug. The tool is kept under pressure during the hardening period, and is subsequently cured at a suitable temperature.

With an alternative method of construction, a dense pre-impregnated, metal fibre reinforcing layer is applied over the facing coat, and is backed up with a mixture of chopped glass fibre and resin, pressure being again applied during the hardening stage.

Tests were carried out to compare the performances of plastics tools of various types, and it is stated that those faced with the steel fibre-reinforced epoxy resin gave very good results in conjunction with backing material containing either steel or glass fibre. Where steel fibre is used throughout, the material is more readily machinable and repairs or modifications can readily be carried out. On the other hand, the production of

(*Continued on page* 1125)

The Fifth Gauge and Tool Exhibition—1

The fifth exhibition of the series organized by The Gauge and Tool Makers' Association, Standbrook House, Old Bond Street, London, W.1, is being held this year in the National Hall at Olympia. Hitherto, these exhibitions have been staged in the New Hall of the Royal Horticultural Society, and the fact that it was necessary to seek greatly increased accommodation affords evidence of the growth of this event, in scope and importance. Sir William Lyons, managing director of Jaguar Cars, Ltd., will perform the opening ceremony on May 13, but the exhibition will start on May 12 and continue until May 21 (10 a.m. to 6 p.m. daily).

From advance information which has been supplied, it is evident that the high standard established by previous exhibitions will be more than maintained, and that the wide range of the industry's products will be very well represented. An excellent opportunity will thus be afforded for engineers to acquaint themselves with the latest developments in this field, which can be of so much value as a means of reducing costs and improving product quality.

Many exhibitors will take advantage of the additional space that it has been possible to allocate to individual stands, to demonstrate the capabilities of various products.

It may also be noted that member firms of the British Power Press Manufacturers Association are participating in the exhibition.

Some of the exhibits which represent new designs or developments are here described, and others will be considered in subsequent issues of MACHINERY.

Optical Measuring Tools, Ltd., Maidenhead. Stand No. 23

Among the wide range of optical measuring equipment displayed on this stand will be the type WP 100 large-capacity projector, which was described in MACHINERY, 91/43—5/7/57. Intended for inspecting contours of all types within its range, and to permit of finishing profile gauges while they are actually projected on the screen, this projector incorporates various advanced features. The magnification obtainable ranges from 10 to 100 ×, and the instrument has a viewing screen measuring 60 by 40 in. This projector will be demonstrated during the exhibition.

Recent developments in precision optical rotary tables made by this company include a new 30-in. diameter indexing plain type. This rotary table has a motorized platen and incorporates an indexing unit which can be operated by decade switches or under punched-card control.

For more rapid indexing, the 16-in. diameter rotary table seen in Fig. 1 will be shown. This table has a power-operated platen and can be used for

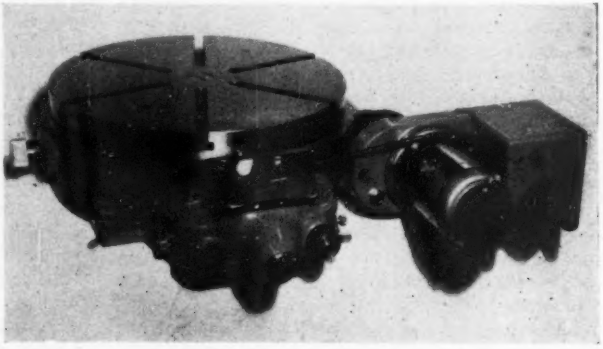

Fig. 1. O.M.T. 16-in. Diameter Rotary Indexing Table for Rapid Indexing and Light-duty Milling Operations

light-duty milling operations in addition to its normal duties. The company will also exhibit their 16-in. diameter optical rotary and inclinable table, which enables angular settings to be made in both directions to within 1 sec. of arc. Readings are taken from precision glass scales, through microscope units which incorporate optical micrometers of the wedge prism type. This equipment was described in MACHINERY, 90/490—1/3/57.

Another item on this stand will be the O.W. 12 optical dividing head, to which further reference will be made shortly in MACHINERY. With a centre height of 3¼ in. and admitting 14½ in. between centres, this unit incorporates a micrometer eyepiece for viewing a scale which may be read direct to within 2 sec. of arc. Other equipment on view will include a toolmaker's microscope, with such accessories as a double-image coincidence ocular, and an internal feeler attachment for measuring small bores, also a selection of standard and large capacity horizontal and vertical comparators. A section of this stand will be devoted to a display of the precision lenses, prisms, graticules, and optical flats, which the company produce for the scientific instrument industry.

There will also be a series of demonstrations on a Newall Optiset jig borer, which incorporates an optical measuring system designed and made in its entirety by O.M.T., Ltd. It may be noted that the sole distributors for this company's products are Newall Group Sales, Ltd., Old Fletton, Peterborough.

Sigma Instrument Co., Ltd., Letchworth, Herts. Stand No. 41

Attention may be drawn to the Sigmaster inspection equipment, which will be shown for the first time in this country. This universal, multi-dimensional, air-gauging equipment was described in MACHINERY, 91/449—23/8/57, and is designed to facilitate the inspection of components produced in quantities which are insufficient to warrant the use of fully-automatic special-purpose inspection machines. A range of interchangeable units is available whereby a multi-dimensional gauging fixture may readily be built up to suit practically any type of component, and the standard kit of parts, as seen in Fig. 2, has been developed for the convenience of users. It is stated that these kits are particularly suitable for research establishments and technical colleges, for example. When assembled, these fixtures are intended for use in conjunction with the well-known Sigma Liquicolumn multi-dimensional indicator, and a typical fixture and indicator set-up will be demonstrated. A Liquicolumn indicator arranged for the quality control of compressor blades will also be shown.

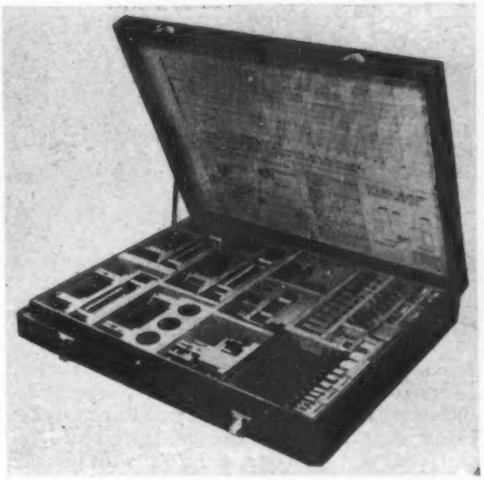

Fig. 2. Sigmaster Standard Kit of Parts

A Sigmatrol automatic size controller will be demonstrated, fitted to a John Lund Precimax cylindrical grinding machine. The components which have been chosen for this demonstration are such that the automatic sizing unit will be seen applied to interrupted cylindrical surfaces, such as shafts with spanner flats.

As representative of the company's final-inspection equipment, a Sigma fully-automatic multi-dimension inspection machine, capable of checking components at the rate of 2,400 per hour, will be on view. In addition, the complete range of Sigmatrol automatic controllers, which are suitable for use with all types of grinding machines, will be shown.

Sheffield Twist Drill & Steel Co., Ltd., Summerfield Street, Sheffield 11. Stand No. 36

This company will show the recently-introduced Dormer Heli-matic screw-locked milling equipment, and the screwed-bore milling cutter and arbor illustrated in Fig. 3 are representative of this range. The arbor has two threaded portions, the outer to receive the cutter, and the inner for the knurled and flatted locking ring, and the threads are of opposite hand. With the cutter in position on its thread, the ring is turned to abut the rear face and ensure firm clamping. There is an alternative form of Heli-matic holder for small-diameter cutters, incorporating an arbor with a tapered and threaded bore at its outer end. The cutter has a parallel externally-threaded shank

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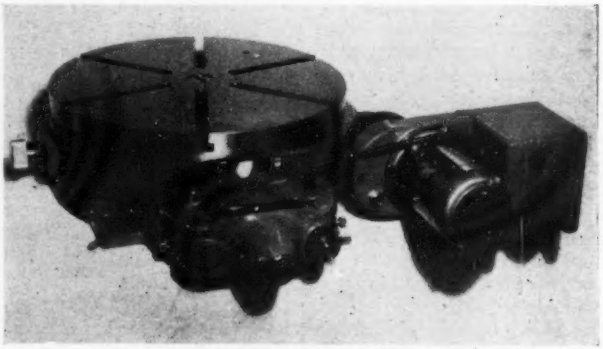

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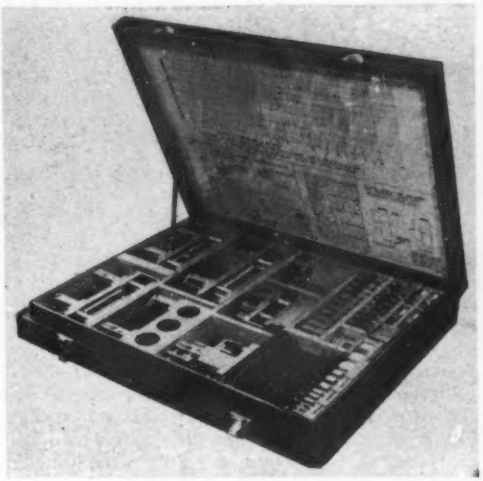

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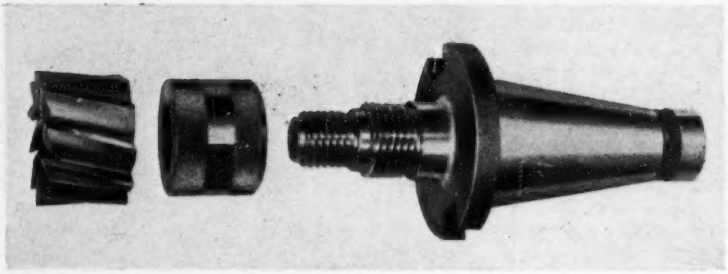


Fig. 3. Dormer Heli-matic Arbor and Screwed-bore Cutter

which can be screwed into a split collet, and the latter, in turn, is screwed into the arbor. After the cutter has been finally screwed home, so that it bottoms in the arbor, the collet is tightened, with the result that the cutter is held positively against the arbor and gripped by the collet-action. Heli-matic tool-holders are available for a wide range of tool diameters, and the arbors can be supplied with Morse, Brown and Sharpe, or B.S. taper shanks.

Two types of Dormer precision machine vices will be exhibited, namely the Down-grip, which was described in MACHINERY, 84/1261—11/7/54, and the solid-jaw type. The former ensures that the workpiece is positively held against an integral, hardened and ground, steel table, by means of a simple built-in mechanism which moves the jaw bodies down as the gripping pressure is applied. The solid jaw vice has one fixed jaw, and is intended for repetition work, where a constant locating face is required for the components. The movable jaw has a compensating action to guard against "lift" and the table is hardened and ground.

The company will also show the Dormer Super-tip masonry drill, which has been developed for work on brick, tile, stone, and other abrasive materials. These drills are being made in a range of sizes from $\frac{3}{32}$ to $\frac{1}{2}$ in. diameter, with flute lengths from $1\frac{1}{2}$ to $3\frac{1}{2}$ in.

John Harris Tools, Ltd., Millers Road, Warwick. Stand No. 39

As sole licensees in this country for the patented Flame-Plating process of the Linde Company of U.S.A., the company will show a range of tools and other components treated in this manner. The process, as fully described in MACHINERY, 91/738—27/9/57, is carried out with the aid of a specially-constructed gun, which incorporates a barrel and a mechanism for loading accurate amounts of powdered material, acetylene, and oxygen into a firing chamber. The powder, usually tungsten carbide, remains suspended in the explosive gas mixture until the latter is ignited by a spark. As a result, the tungsten carbide particles are discharged from the barrel at a very high velocity, and, as they are heated to plasticity, embed themselves in the surface of the workpiece, where a micro-welding action takes place. The coating on the workpiece can be built-up to thicknesses ranging from 0·002 to 0·010 in., and although the temperature in the spraying nozzle may rise to 6,000 deg. F., that of the workpiece rarely exceeds 400 deg. F., so that there is little possibility of distortion occuring, or of the metallurgical condition of the parent metal being changed.

This process has been used by the company for plating such items as plug and ring gauges, cold forming dies, wire forming mandrels, core rods, and turbine engine seals. It is claimed that flame-plated plug gauges have a life three times as long as those made of solid sintered tungsten carbide, and 20 times as long as those which have been hard chromium-plated. The company report that, up to the present time, tungsten carbide only has been applied by this process, but the use of aluminium oxide is being investigated.

In addition to the display of parts treated by this flame-plating process, a representative range of the firm's products in the field of standard and special hand and nut taps, plug and ring gauges, dies, and solid tungsten carbide gauges, will be shown on this stand.

Crawford Collets, Ltd., Tower Hill Works, Witney, Oxfordshire. Stand No. 54

Mention has already been made in MACHINERY, 92/627—14/3/58, of the Crawford hydraulic chuck, which is used in conjunction with the company's range of Multibore collets, and a representative selection of both items will be shown on this stand. A feature of the chuck is that it incorporates a self-contained hydraulic system, and movement is imparted to the fluid, and thence to the inner sleeve, by means of a screw in the body portion. The inner sleeve has a tapered bore, and is moved axially to close the collet. A range of Multibore collets is made to cover diameters from $\frac{1}{8}$ to 2 in., and a patented rear support is incor-

porated which prevents the collet from bell-mouthing when short workpieces are gripped. These collets are of the dead-length type, and comprise a number of hardened and ground steel segments between which spring steel pieces are interposed. The segments are retained, to form a single self-contained assembly, by ring-shaped spring clips.

A wide selection of conventional precision collets and feed fingers of all types, for automatics, capstan lathes, and milling and drilling machines, for example, will also be on view, together with oversize head, disc and ring collets, expanding mandrels, and soft blanks, which may be machined to suit requirements. Mention may also be made of the Crawford Trugrip collet chuck, which is available in two sizes, of 1- and 2-in. capacity.

Thomas Mercer, Ltd., Eywood Road, St. Albans, Herts. Stand No. 123 (Gallery)

Dial gauging equipment to be exhibited will include dial indicators from 1⅛ to 4 in. diameter, with both inch and metric readings; cylinder gauges for bores from ½ to 36 in. diameter; crankshaft gauges; dial indicator test sets; boring bar gauges; magnetic base sets; Precimeter heads; bench gauges; and extensometers.

In addition, there will be standard dial type and gauge units in various forms, together with a range of gauging heads, gap gauges, and air rings, for the accurate measurement of internal and external diameters, lengths, depths, thicknesses, and tapers. Units can be supplied with a single 4-in. diameter, and with single or twin 6-in. diameter dials.

The multiple liquid column air gauge unit, which indicates changes in dimensions to a magnification of 5,000:1, will be shown in London for the first time, and another exhibit will be an electro-air gauge unit, whereby the measurement is sensed pneumatically and transmitted as an electrical signal by means of precision pressure switches.

Where some dimensions of a component must be rapidly checked to fine, and others to coarser limits, it may be convenient to employ a fixture which incorporates both air and dial gauge units. An example of such a fixture, with three dial gauges for the coarser limit dimensions, and one air gauge unit for a close-limit dimension, is shown in Fig. 4, and is typical of those made by the company.

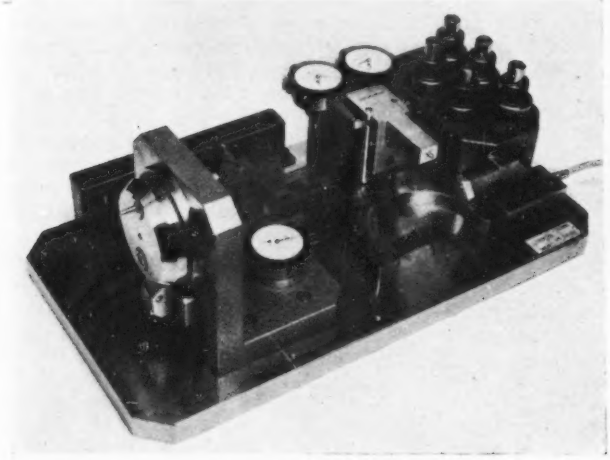


Fig. 4. Mercer Inspection Fixture with Three Dial Gauges for Checking Coarser Limit Dimensions, and One Air Gauge Unit for a Close-limit Dimension

J. Goulder & Sons, Ltd., Kirkheaton, Huddersfield. Stand No. 146 (Gallery)

Attention is drawn to the company's new No. 4 rolling gear testing machine shown in Fig. 5, which will be exhibited on this stand. This instrument will admit gears up to a maximum of 48 in. diameter, and attachments are available for shaft gears up to 32 in. long and 20 in. diameter, also for worms and wheels, bevel gears, and internal gears. A power-operated rotary table can also be supplied for use with this machine. The nominal centre distance is set by means of a scale and vernier, and deviations from this setting are indicated on the 4-in. diameter dial gauge seen at the front. An electrical recording system can be fitted, which will give amplifications between 100 and 5,000×, and provide a permanent record of the gears being checked. The sensitive spring-loaded saddle is mounted on precision balls, and may be moved by hand or power in either direction, by means of a hand-wheel on the front of the bed or a lever on the control panel. Arrangements are incorporated for lifting this saddle off its track, when heavy gears are being loaded, in order to avoid accidental damage to the slideways.

The Goulder lead measuring machine, which was described in MACHINERY, 91/544—6/9/57, will be exhibited for the first time. Gears up to 14 in. diameter by 5 in. long can be mounted on the faceplate of this

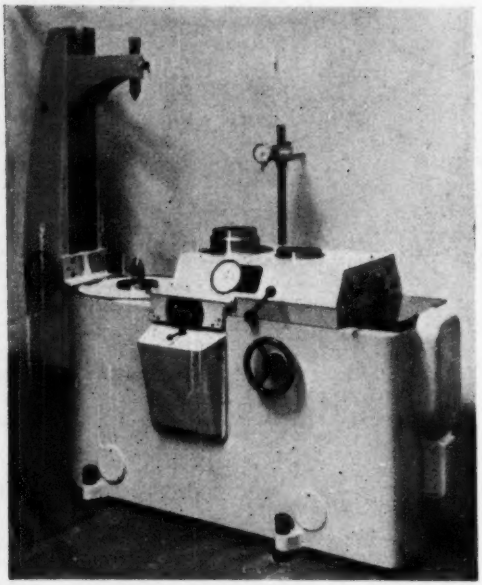


Fig. 5. Goulder No. 4 Rolling Gear Tester

machine, and an attachment can be fitted to enable shaft gears up to 8 in. diameter by 12 in. long, weighing up to 100 lb., to be accommodated between centres. Readings are obtained by means of a Talymin (Taylor, Taylor and Hobson, Ltd.,) side-acting gauging head, which is connected to a recording head whereby a chart of the lead errors is produced. Alternatively, a Société Genevoise micro-indicator can be fitted.

The company's No. 1, 2, 4, and 9-in. and 16-in. S-type rolling gear testers will also be on view, and these machines cover a wide range of gears of various diameters, pitches, and weights. As representative of other equipment made by the company, a pitch checking attachment, an involute tester, and various types of recording systems will be shown on this stand.

Protolite, Ltd., Central House, Upper Woburn Place, W.C.1. Stand No. 45

Demonstrations will be given daily, on this stand, of Prolite Futur Mills and Prolite rotary burs, both working under production conditions. Prolite dies for drawing ferrous and non-ferrous wire, rod, strip, and bar will be on view, also a selection of tubes produced with the company's drawing dies and plugs.

In addition to examples of Prolite cemented tungsten carbide tips, a number of tipped turning tools, milling cutters, drills, reamers, and jig boring tools, will be displayed, also carbide drills, and slitting saws. Other exhibits will include Prolite dies for drawing, blanking, and piercing, as representative of the company's activities in the sheet-metal working field, forming tools, gauges, and spin-riveting tools.

Among products of Murex, Ltd. (Powder Metallurgy Division), which will also be shown, may be noted tungsten, molybdenum, niobium, tantalum, and zirconium, in the form of rod, wire, and sheet. This division also makes sintered permanent magnets in Alnico, Alcomax, and Hycomax, under the trade name Sincomax.

Richard Lloyd, Ltd., Galton House, Elmfield Avenue, Tyburn, Birmingham, 24. Stand No. 9

On this stand there will be a representative selection from the company's range of Galtona-O.K. serrated blade cutters of various types and sizes, for such operations as milling, facing, boring, reaming, counterboring, and hollow milling. These cutters can be fitted with blades of high-speed and super-cobalt high-speed steel, Stellite, or of the cemented carbide tipped type. Examples of the Galtona-O.K. range of cemented carbide tipped facing cutters, which are now available, will be shown, as will ground thread taps to B.S.I. tolerances in a wide range of thread forms. The Galtona pneumatic machine vice which will be exhibited is particularly intended for holding small and medium size components for quantity production milling operations, and special jaws can be supplied for these vices, if required. When operating on an air supply of 80 lb. per sq. in., a gripping force of 1¾ tons is exerted between the jaws.

Attention is drawn to the newly-introduced range of Galtona-O.K. serrated bit tool-holders, one of which is shown in Fig. 6. Owing to the restrictions on imports from the U.S.A., the company is now making these tool-holders in this country, and, at present, are producing three styles,

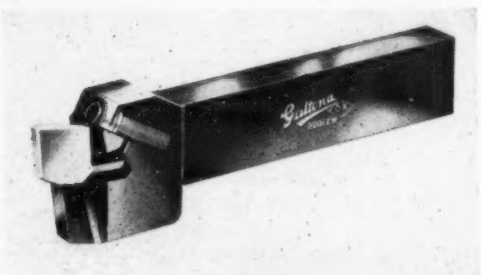


Fig. 6. Galtona-O.K. Serrated Bit Tool-holder

namely, drop-head, as illustrated, straight base, and goose-neck. Initially, a range of 19 shapes of tool bit is being made, of both high-speed steel and carbide tipped types, but additional shapes may be added later, according to demand. The bit may either be secured by front locking, as shown in the figure, or by back locking. For the latter method, the clamping screw is extended through the body of the shank and engages with a square-ended, internally-threaded sleeve housed at the rear.

The tool bit has a serrated base and is held in place by the inclined back stop, which bears the full thrust of the cut. With this arrangement, the clamping system is required to hold the bit only, and does not take any of the cutting pressure. The serrations enable the bit to be adjusted sideways when necessary, to allow for regrinding operations when the cutting edge becomes dull.

Toolworks, Roebuck Road, Chessington, Surrey. Stand No. 108 (Gallery)

On this stand there will be a representative selection from the wide range of precision tools, jigs, and prototype equipment made by the company, which includes compound blanking and piercing, shaving, deep-drawing, and lamination tools. A large proportion of this firm's work is concerned with the design and production of special-purpose tools and machines, which cannot readily be exhibited, including moulding presses, grinding machines, coil and armature winding machines, and special milling machines.

B.I.P. Tools, Ltd., 147 Tyburn Road, Erdington, Birmingham. Stand No. 40

The display on this stand will feature some of the company's injection moulds for thermoplastics materials, and compression and transfer moulds for thermosetting materials. A typical example of the company's work in this field is shown in Fig. 7, which illustrates a 2-impression transfer mould for the production of telephone hand-sets. This equipment was made for a well-known firm in Holland, and incorporates air-cylinders for withdrawing the curved cores. The air-cylinders seen at the front are employed to facilitate insert loading. A working exhibit on this stand will provide an example of correctly-planned tooling for automatic moulding. A second mould will be shown which, although not fully automatic, will serve to illustrate methods which may be employed in modern plastics tooling in order to minimize errors due to the human element.

A number of die casting tools will be on view as representative of the company's activities in this field. In addition, sample pieces made by various special processes, such as cold-hobbing steel and hot-hobbing beryllium-copper, also thread-milling and grinding, will be displayed, as will some examples of the firm's induction heating equipment.

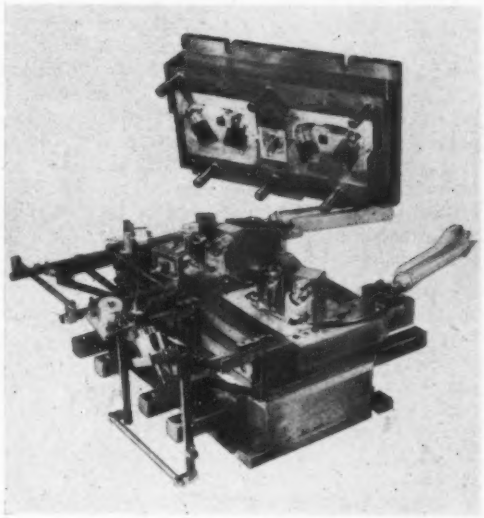


Fig. 7. 2-impression Transfer Mould for Telephone Hand-sets, made by B.I.P. Tools, Ltd.

English Steel Tool Corporation, Ltd., Openshaw, Manchester, 11. Stand No. 33

Of particular interest will be the demonstration of turning operations with Sintox ceramic cutting tools which will be given on this stand. These tools, for which the company is the sole distributor in the United Kingdom, are made by Lodge Plugs, Ltd., Rugby, and the demonstrations will be carried out on a Dean, Smith and Grace 13- by 30-in. centre lathe. Sintox ceramic cutting tools were described in MACHINERY, 90/781—5/4/57. They are of the throw-away type, and are made in three shapes, namely, round, square, and diamond. The main constituent of Sintox is aluminium oxide, and its intense hardness is maintained even at elevated temperatures, so that high cutting speeds can be employed. The holders for these tools are made at the company's works at Manchester from a specially-selected alloy steel. Sintox tips may be reground with a silicon carbide wheel, but the use of a diamond wheel is recommended. Tests have shown, however, that it is more economic to throw the tips away after all the cutting edges have been used, rather than to undertake regrinding.

Other exhibits will comprise examples from the wide range of cutting tools made by the company, including taps, dies and chasers, twist drills and sockets, gear cutters, hobs, and broaches. Various sizes of the firm's patented adjustable reamers will be on view, also a comprehensive selection of milling cutters, slotting cutters, slitting saws, boring tools, files, rasps, and hacksaw blades. It may be noted that the company undertakes the manufacture of special cutting tools to customers' individual requirements, and examples of their work in this field will be on view.

Raymond F. Thompson (Engineers), Ltd., Harlow, Essex. Stand No. 7

On this stand will be shown press tools, jigs, and fixtures, which have been designed, built, and tried out by the company. Moulds for the injection and compression forming of plastics will also be displayed, together with typical workpieces which have been produced with the aid of equipment supplied by the firm.

Talbot Tool Co., Ltd., Grip Works, Roedale Road, Brighton. Stand No. 102 (Gallery)

An extensive range of jig bushes to be shown by this company will include Standard Grip types for drilling and reaming, which conform to B.S. 1098 : 1953, and are made from high quality steel, hardened and precision ground. Another type of bush, known as the Polygrip, is intended for use in plastics and moulded jigs. A typical glass fibre jig is shown in Fig. 8, together with examples of these bushes, and it will be observed that they are recessed and serrated to prevent them from turning or moving axially. Exhibits will also include Nurogrip straight-serrated bushes for use in laminated jigs, together with Grip toolmakers' buttons, lock screw locating jigs, and locking screws.

An item of particular interest will be the chest containing jig bushes which was carried on the Mayflower II, and has recently been brought back to the country after being displayed in many parts of the U.S.A. and Canada.

A. Shaw & Son (Diamonds), Ltd., Waterloo Road, North Circular Road, London, N.W.2. Stand No. 5

Among the wide range of industrial diamond tools to be displayed may be noted turning and boring tools, grinding wheel dressers, and indenters for use with Vickers, Firth, and Rockwell hardness testing machines. Diamond impregnated laps for tungsten carbide will also be on view, and will be demonstrated on a Stedall carbide tool grinder.

George Taylor & Son (Engineers), Ltd., Swan Lane, Coventry. Stand No. 143 (Gallery)

On this stand there will be a display of gauges made by the company in "super-steel," which is claimed to ensure exceptional life. These gauges will be shown in conjunction with the parts for which they were designed, and it may be noted that a test was recently carried out, during which a super-steel and an ordinary steel gauge were used to check a number of En.8 components which had been chromalized. After a total of 5,500 parts had been inspected, the gauges were checked for size, and it was found that the ordinary steel gauge had worn to the extent of 0·005 in., whereas the super-steel gauge had worn to the extent of only 0·00035 in., so that it was still within the permitted dimensional limits.

In addition to the gauges already mentioned, the company will show a representative range of inspection, milling and grinding fixtures, and impact extrusion tools, which they have made for Bristol Aero Engines, Ltd., and British Thomson-Houston, Ltd. Examples of Taylor screw- and plain-plug and ring gauges, conforming to B.S.S. specifications, will be on view, also some non-standard right- and left-hand screw gauges.

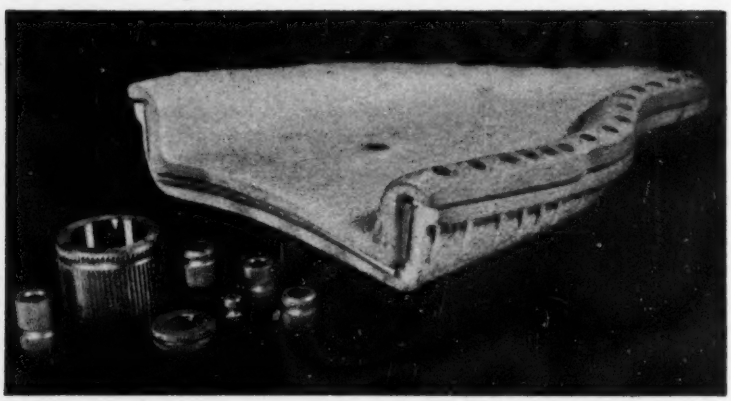


Fig. 8. Glass Fibre Jig Incorporating Talbot Polygrip Drill Bushes

Other exhibits will also include examples of the company's production thread-grinding, plug gauge blank and handle work, and there will be a special display showing the various stages in the production of plug and ring gauges. It may be noted that this company supplies special-purpose gauges and inspection equipment, to customers' individual requirements.

Impregnated Diamond Products, Ltd., Tuffley Crescent, Gloucester. Stand No. 38

Neven diamond tool exhibits will range from saws of large diameter to very small mandrels for internal grinding, and will include the type 920 cup wheel for grinding tungsten carbide, also peripheral wheels, cutting discs and drills for use in various industries. In addition, diamond wheels will be demonstrated on the G.F.3 tool and cutter grinding machine (MACHINERY, 86/247—4/2/55), and on the recently-introduced G.F.O. oscillating machine for grinding and lapping tungsten carbide tipped tools, which is being exhibited for the first time.

The firm's Sparcatron Mark III spark-machining equipment, for the production of dies of all types, will be shown in its latest form with a large table tank. Of particular interest will be the Sparcard equipment (MACHINERY, 92/687—21/3/58), which is another recent development and provides for surface hardening high-speed steel tools by a metal deposition process. It is claimed that with this treatment increased tool life can be obtained, both for normal machining and for operations on the newer high-tensile and heat-resistant materials.

The British Tap & Die Co., Ltd., Triangle Works, Town Road, Edmonton, London, N.9. Stand No. 46

This company will exhibit representative examples from their wide range of taps and dies. Prominence will be given to the Whirlwind patent high-speed steel, ground-thread button dies, with thread forms ground from the solid. The cutting performance of these dies will be demonstrated by a simple machining set-up. Other exhibits will include Whirlwind Super and standard high-speed steel, ground-thread taps, a range of Triangle brand taps, dies, die nuts and tap wrenches, and Stronghold American-pattern stocks and dies.

Pitter Gauge & Tool Co., Ltd., Market Street, Woolwich, London, S.E.18. Stand No. 44

Among the items to be shown on this stand, attention may be drawn to the P.V.E. Micro-Bar height setting gauge which has recently been developed by the company. In Fig. 9 are shown front and side views of this instrument, which

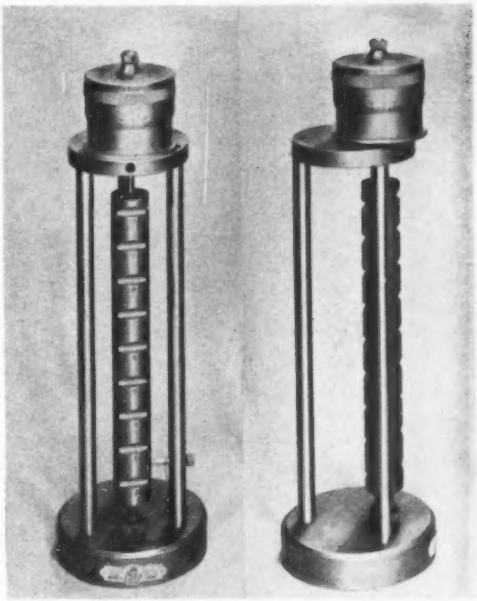


Fig. 9. P.V.E. Micro-Bar Height Setting Gauge

comprises an accurately notched bar supported between two discs. The lower disc serves as a base for the instrument, and is of heavy section, ground on the bottom face, and three equally-spaced tie-bars serve to support the upper disc, which incorporates a micrometer, with a large-diameter drum. Projecting vertically downwards, the anvil of this micrometer enters a hole in the top of the notched bar, and makes contact with a hardened steel ball. At the lower end, the measuring bar is bored to receive a spring, and another steel ball, and the latter rests on the top of a stationary anvil secured to the base plate. It will be noted that the measuring bar has upward- and downward-facing notches, in pairs, the horizontal faces of each pair being accurately matched. The measuring bar can be rotated about its axis, and, as can be seen in the view at the left, a spring-loaded plunger is provided to locate it in the required position.

In operation, this instrument is used in conjunction with a suitably-mounted dial indicator, which is set to the height of the surface to be measured. The stylus of the indicator is then brought into contact with the appropriate notch on the measuring bar, and the micrometer is used to bring the indicator needle to zero. By adding the reading on the micrometer drum to the number of whole inches represented by the selected notch,

the height of the work surface is obtained. Heights between 2 and 11 in. can be measured with this instrument, in increments of 0·0002 in.

Examples from the complete range of P.V.E. products will also be displayed, including slip gauges, length bars, sine bars, sine tables, and co-ordinate tables. Attention is drawn to a number of stick micrometers, including a new miniature set, and to the recently extended range of sine centres. Measuring machines for both plain and threaded gauges and components will be shown, and there will be a selection of parts which have been made specially to customers' requirements.

Lea-Francis Cars, Ltd., Much Park Street, Coventry. Stand No. 141 (Gallery)

Items to be shown as representative of certain of the activities of this firm of precision and general engineers will include jigs, fixtures, and gauges, also a trunnion fixture which is the subject of a patent application. This fixture provides for the rapid indexing of jigs, so that the time required between machining operations can be reduced. The company also undertakes prototype and development work, and the manufacture of components and assemblies for the aircraft, motor vehicle, and general engineering industries.

Lenchs (Birmingham), Ltd., Great Hampton Street, Birmingham, 18. Stand No. 151 (Gallery)

In Fig. 10 is shown a set of nine jig boring tools which can now be supplied in a wooden stand. These tools are tipped with Oakaloy ES cemented carbide, which has been developed primarily for operations on such materials as toughened tool steels, also manganese and chrome nickel steel. It is stated that this carbide, by reason of its high wear resistance, is also suitable for machining short-chip materials, such as cast iron, bronze bars, and plastics.

Another exhibit will be a set of lamination tools incorporating punches and die inserts made from a new grade of Oakaloy carbide which combines good cutting qualities with high wear resistance. Tools of this type can now be supplied by the company for producing a wide variety of parts.

Coley Bros. (Tools), Ltd., Birmingham Factory Centre, Kings Norton, Birmingham, 30. Stand No. 58

Various additions have been made to the range of Exacta press tool die sets made by this company, and several of these will be displayed and demonstrated on power presses on this stand. It may be noted that a number of all-steel die sets particularly intended for use in the motor-car and agricultural equipment industries has recently been developed, in a range of sizes up to a maximum die space of 24 by 36 in. All Exacta die sets can be fitted with the company's linear-motion ball-bearing bushes, if required, and, as specialists in these anti-friction, pre-loaded, chatter-free bushes, the company will be showing a comprehensive range, including the D.S.P., G.P.B., and U.T.B. types.

Selected items of toolmakers' standardized accessories from the Exacta, Steadfast, and Reliance ranges will also be on view, including demountable pillar sets, mould guide pins and bushes, press clamps, toggle clamps, and a new roller-type pry-bar which enables heavy weights to be manipulated with ease.

James Chesterman & Co., Ltd., Sheffield, 11. Stand No. 152 (Gallery)

A fully-representative range of the company's products will be exhibited, including the 48-in. triangular-pattern beam vernier height gauge, and the 8-ft. machine bed straight-edge, which is stated to be accurate to within ±0·0005 in. over the full length.

Examples of vernier height, caliper, and depth gauges will be on view, also feeler, centre, thread, thickness, wedge, and wire gauges. A selection of engineers', sheet-metal workers', and draughtsmen's straight-edges, of both plain and graduated forms, will be shown, in addition to a comprehensive selection of steel rules of many types, including folding, flexible, printers', and pattern-makers'

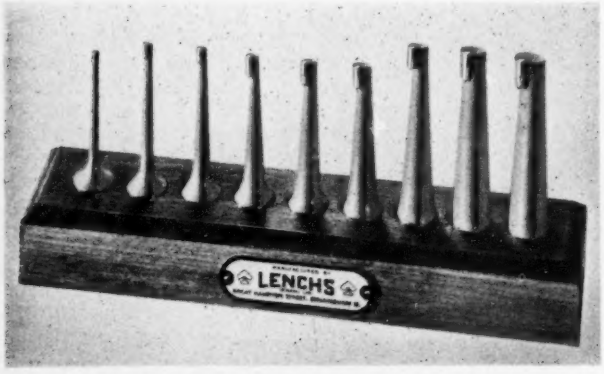


Fig. 10. A Set of Jig Boring Tools Tipped with Oakaloy ES Cemented Carbide

contraction rules. There will also be steel, plastics-coated linen, and linen metallic measuring tapes and bands for engineers and surveyors, together with examples of specially-machined scales, tapes, and verniers which are graduated to special order. It may be noted that the company undertakes the production of special linear measuring equipment for incorporation in machines of various types.

A. A. Jones & Shipman, Ltd., Narborough Road South, Leicester. Stand No. 10

This company will exhibit a wide range of engineer's small tools, principally for use with lathes, drilling machines, and universal grinding machines, and amongst them may be noted lathe tool-holders, boring bars and parting-off tools (of both English and American patterns), knurling tools and knurls, lathe carriers, mandrels and sockets, and centre drills. Of particular interest will be a display of a range of tool-holders designed for use with throw-away tips. The company's machine vices, arbors, and drifts, for use with drilling machines, will also be on view, and amongst other equipment may be noted dividing tables, compound tables, vee-blocks, and angle plates.

The range of Jones-Shipman hacksaw blades, will also be represented, as will a selection of the mandrel and straightening presses handled by the company. Jones & Shipman are the sole selling agents for the J. & S.-Aldridge range of cutting tools, which includes standard milling cutters, end mills, and reamers, for example, and a selection of these items, in sizes conforming to British Standard Specification, will be shown. In addition, there will be a number of standard size ground thread taps with straight and spiral leads, both in high-speed and carbon steel, also examples of J. & S.-Lunzer rotating centres, which are made in a large range of sizes and types of shank.

J. B. Purefoy Unit Tooling, Ltd., Upper Tilt Works, Cobham, Surrey. Stand No. 27

Recent additions to the range of standard parts for jigs and fixtures made by this company have increased the total number of different components now available from stock to more than 750. A representative selection of these parts will be displayed on the stand, and the new items to be shown will include latch plate sections, sandwich jig bases, flanged circular and rectangular blanks, single- and double-ball hand levers and cam levers, various types of cam clamps and clamp plates, swivel pads, fork-ends, and extension nuts.

A typical assembly built up from the firm's products is seen in Fig. 11, which shows a centre-cam clamp consisting entirely of standard

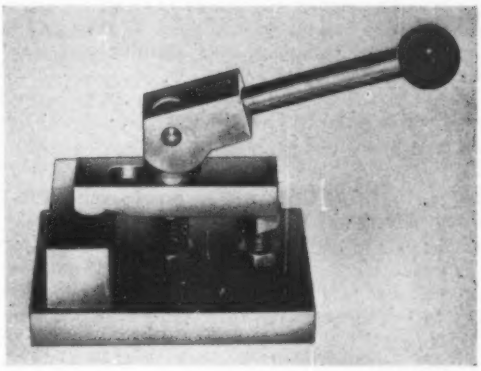


Fig. 11. Centre-cam Clamp Assembled Entirely from Purefoy Standard Parts

parts. Various types of cast-iron sections will be displayed, including H-, U-, T-, and L-sections, webbed L- and T-sections, V-sections, and square and rectangular hollow blocks. These sections are available in various lengths, up to a maximum of 25 in. Clamp screws, studs, wing-nuts, knobs, and levers can be supplied with Unified thread forms, in addition to the normal B.S.F. and Whitworth ranges.

The Mollart Engineering Co., Ltd., Kingston-by-pass, Surbiton, Surrey. Stand No. 160 (Gallery)

Of particular interest on this stand will be a display of the company's range of high-frequency internal grinding spindles. Mention has already been made in MACHINERY, 84/1205—4/6/54, of these spindles, which are available in five sizes with fixed and removable quill assemblies, minimum and maximum spindle speeds of 20,000 and 36,000 r.p.m. being obtainable with the largest, and 80,000 and 90,000 r.p.m. with the smallest, sizes in the range. Units which provide steplessly-variable spindle speeds can be supplied, and the vibration-free direct drive is taken from a high-frequency induction motor supplied by a B.T.H. inductor/alternator. The latter is driven by a separate motor, and these two units are mounted on a base-plate to form a self-contained installation. The spindle motor is surrounded by a water jacket, for cooling purposes, and lubrication for the bearings is provided by an oil-mist system. One of these units will be shown running.

The company will also display an improved version of the well-known Mollart universal ball joint, as well as the latest addition to the range of Hooke's type couplings, which has a maximum torque capacity of 50 tons-in. A fully-representa-

tive selection of gauges, tools, and fixtures will be on view, and will include male and female spline, screw- and plain-ring and plug, receiver, and combination gauges.

As indicative of the wide variety of precision work which is undertaken by this company, there will be a number of prototype aircraft components.

The Acclim Co., Ltd., Walton Road, Hoddesdon, Herts. Stand No. 153 (Gallery)

Examples from the range of ground thread and cut thread taps made by this company will be on view, and facilities will be provided for demonstrating various types of taps on different materials. The complete range covers sizes from 12 B.A. and 0-80 NF. up to 4-in. B.S.P., and the types include standard straight-fluted hand taps with taper, second, and bottoming lead; spiral pointed hand taps, with two, three, or four flutes; and quick spiral taps for blind hole work. It may be noted that special taps for use in conjunction with Pearns tappers, also machine nut, socket, and Ward tapper taps are made. Tap blanks are stocked, fully-finished except for the threads, so that non-standard taps can be supplied quickly to order.

J. Parkinson & Son (Shipley), Ltd., Shipley, Yorks. Stand No. 131 (Gallery)

A complete range of "Parkson" gear testers will be exhibited, including the newly-developed 4½-in. size, which is shown in Fig. 12. This tester will handle both internal and external gears, and is shown fitted with the close small-centre attachment which is used when testing gears with a centre distance of less than 1 in. It may be noted that this tester—also the 9-in. size—is fitted with a load indicator, which, in conjunction with the adjustable spring, enables pressures ranging from 6 to 32 oz. to be applied, according to the pitch of the gears being tested. As may be seen in the figure, the knurled knob for adjusting the spring pressure projects through a slot in the top face of the right-hand saddle, and the various spring pressure settings are indicated by graduations along the sides of this slot. The usual attachments for bevel and worm gears are available for use with both testers.

Examples of the company's 6-in. and 7-in. size dividing heads will also be shown.

A complete range of attachments for Parkson milling machines will be on view, and it may be noted that some of them can be adapted for use on other makes of machines. In addition there will be a selection of milling machine vices, arbors, and collets.

Cutters for use with the company's Sunderland gear planers will be displayed, including types for spur, spiral, and double helical gears, in a range extending up to 5 in. circular pitch, also examples of cutters for machining chain sprockets, ratchets, and other shapes.

Other exhibits will include a range of bench vices of the continuous screw and quick-action types, which can be supplied with either plain or swivel bases, as required.

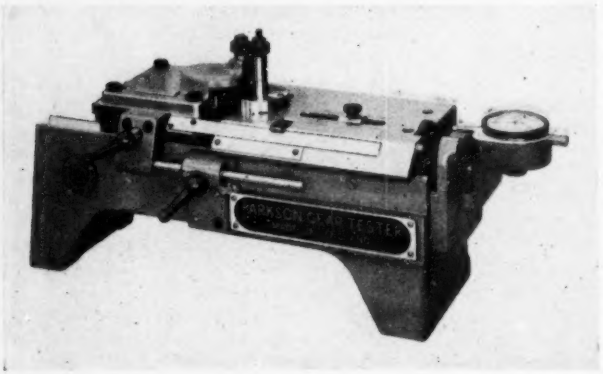


Fig. 12. Parkson 4½-in. Gear Tester

Mulhead Engineering Co., Ltd., Victoria Works, 136–138 Great North Road, Hatfield, Herts. Stand No. 112 (Gallery)

The Mulhead rotary Auto-Matic seen in Fig. 13 will be shown set up for drilling telephone exchange pole pieces, and it may be noted that the rotary indexing table is built-in as part of the machine. Tooling, in this instance, will consist of a standard multi-spindle head with bush plate, and a multi-station fixture mounted on the rotary table. Attention is drawn to the angularly-disposed head, seen at the right, which produces a hole that cannot be drilled with the multi-spindle head.

Two pole pieces are loaded into the fixture at the front of the machine, while the drilling head is feeding down, and the cycle time for this workpiece, which has 11 holes, is 12 sec. In some instances, the downward movement of the drill head is utilized to turn the workpiece through 180 deg., about a horizontal axis, at an intermediate station, so that operations can subsequently be performed on the reverse side.

Mulhead standard multi-spindle

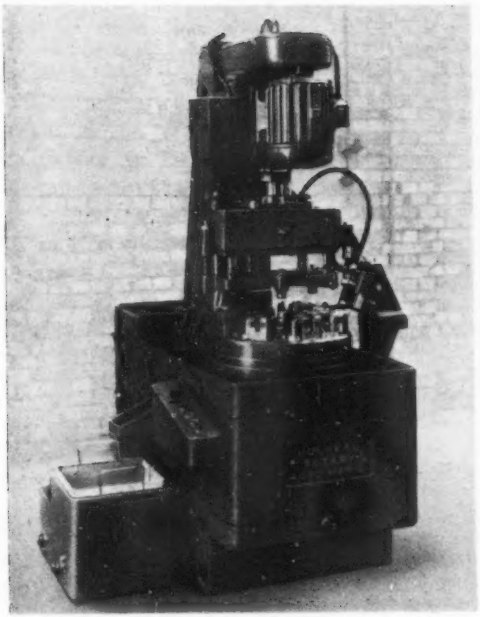


Fig. 13. Mulhead Rotary Auto-Matic Machine Set Up for Drilling Pole Pieces

drilling and tapping units will also be demonstrated on a Herbert vertical drilling machine and a Huller tapping machine. The latter will be seen fitted with a special pneumatically-operated rotary table so that the work can be loaded and unloaded at the front while tapping is in progress at the rear stations.

Heads, bush plates and base castings can be supplied for drilling up to ¾-in. diameter, and tapping up to ½-in. diameter, on pitch circles ranging from 2⅝ to 10½ in. diameter.

The Horstmann Gear Co., Ltd., Newbridge Works, Bath. Stand No. 165 (Gallery)

The methods employed by this company for the manufacture of caliper-type screw gauges were described in MACHINERY, 89/716—28/9/56, and a number of these gauges will be on view. A feature of the design of this equipment is that the gauging anvils are free to swing about a pivot, and have a limited amount of longitudinal movement. In consequence, not only can the effective distance between the anvils be varied, but the caliper can repeatedly be adjusted to compensate for wear during service.

Particularly suitable for checking threads on shouldered workpieces, these calipers can be used for right- or left-hand threads, as the thread is of compensated form in relation to the helix angle. These caliper-type screw gauges are available as a "go" and "not-go" combination. Alternatively, the "go" and "not-go" anvils can be supplied in separate frames.

A selection of the company's plug and ring gauges, of both the plain and screw types, will be shown, and a representative range of machine-relieved instrument gear hobs will also be included in the exhibits.

Nuckey, Scott & Co., Ltd., Warrior Works, Lea Valley Road, Ponders End, Enfield, Middlesex. Stand No. 128 (Gallery)

Warrior products displayed on this stand will include ground and cut thread taps and dies in high speed and carbon steels; American pattern 2-piece stocks and dies; ratchet type pipe sets; die-head chasers; tap extractors; and screw gauges. There will also be examples of new and improved designs of tools for threading materials which normally present difficulty, and tools which have received various special surface treatments to ensure better performance or life when operating under severe conditions.

Kemworthy Jig & Press Tool Co., Ltd., 25-29 High Street, Colliers Wood, London, S.W.19. Stand No. 19

Exhibits on this stand will include the Harig grind-all fixture, which the company is to produce in the near future. This fixture has been specially designed to facilitate grinding formed piercing punches, and it is claimed that, with its aid, punches for symmetrical and irregularly shaped holes can be speedily and accurately ground. As may be seen from Fig. 14, the fixture has a body of T-section which measures approximately 4 by 3 by 4 in. An accurate indexing plate rotates in this body, and carries a V-block on its front face, which can be adjusted to either side of the central position, in a guideway.

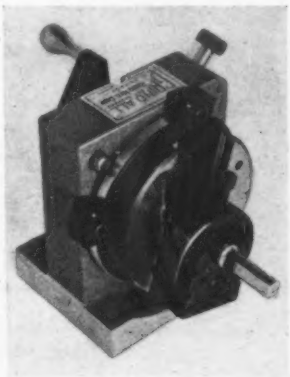


Fig. 14. The Harig Grind-all Fixture for Grinding Formed Piercing Punches

After the shank of the punch has been ground to a circular form by conventional methods, it is mounted in the V-block of the fixture. By a combination of radial adjustments of the V-block and rotary adjustments of the indexing plate, the form can rapidly be produced on the punch, on a surface grinding machine. The fixture body, indexing plate, and V-block are made from steel, hardened and ground, and the overall accuracy is guaranteed to within 0·0002 in. A wheel-dressing attachment is also available to facilitate the production of convex and concave forms. The grindall fixture can be used for inspection purposes, and is of sufficiently robust construction to enable it to be employed for light precision-machining.

Toolmasters, Ltd., Connaught Works, Uxbridge Road, Hillingdon Heath, Middx. Stand No. 106 (Gallery)

A feature of this stand will be a display of the company's range of Diaform precision grinding wheel forming equipment. There are three types of these attachments, for cylindrical, surface, and jig grinding machines, and each of them will be demonstrated fitted to a suitable machine. Of particular interest will be the latest addition to the Diaform range, known as the type 5/1, and this attachment, which is shown in the accompanying Fig. 15, will be demonstrated on a Jones & Shipman 540 surface grinding machine. Of the horizontal type, the 5/1 Diaform can be fitted to the grinding spindle bearing box of a surface grinding machine, and has a 10:1 ratio pantograph, with capacity for forms up to 1-in. wide by ½-in. deep on wheels up to 10-in. diameter.

The standard B.T. vertical Diaform will be demonstrated on a Hauser jig grinding machine, set-up for cutting a standard tooth form on an internal gear shaving die, and the type 10/2 Diaform attachment will be seen on another Jones & Shipman machine arranged for grinding circular formed rolls. This latter attachment was described in MACHINERY, 84/1260—11/7/54 and 88/1299—29/6/56, and is intended for use on most cylindrical grinding machines of 8- by 22-in. or similar capacity. With this unit, profiles to a maximum of 2-in. wide by 1-in. deep can be produced on wheels up to 14-in. diameter, and the pantograph motion gives a reduction of 5:1 between the movement of the stylus pin and the diamond carrier.

In addition to the wheel forming equipment already mentioned, this company will show a number of segmental tools and dies from the wide range made by their toolmaking division.

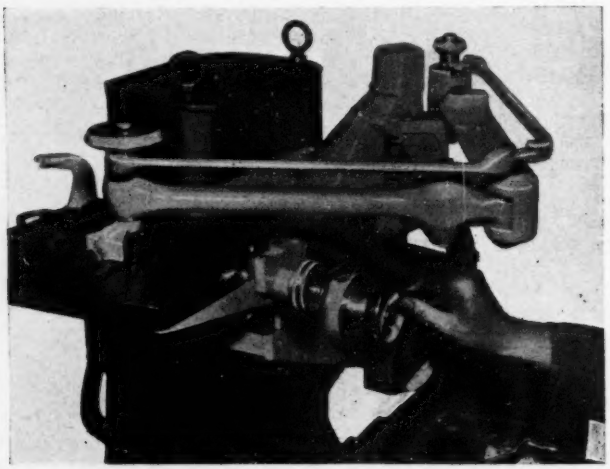


Fig. 15. Toolmasters Type 5/1 Diaform Precision Grinding Wheel-forming Attachment

The Walco Engineering Co., 30 Lincoln Road, Olton, Birmingham. Stand No. 114 (Gallery)

Several examples of the tooling equipment made by this company, including boring bars, toolholders, arbors, and trepanning heads, will be shown, also a number of jigs and fixtures representative of the wide range supplied. Also on view will be a comprehensive selection of the company's inspection equipment, comprising gap, single- and double-ended plug, receiver and position, and form gauges. In addition, it may be noted that this company undertakes machine tool sub-assembly work, and has capacity for machining up to 24 in. diameter, or cube, and for universal grinding operations on parts up to 12 in. diameter by 40 in. long.

J. E. Baty & Co., Ltd., Burgess Hill, Sussex. Stand No. 17

Several new units have been added to the extensive range of dial indicators and measuring equipment produced by this company, which is now being made in a new factory at Burgess Hill, Sussex. New items include a magnetic base stand of increased dimensions, with a pull that is at least twice that of the original, smaller model. A moderately-priced test set, with a back-plunger indicator and accessories, has also been introduced, and the exhibits will include a selection of plain, pin and plug gauges, also measuring wires.

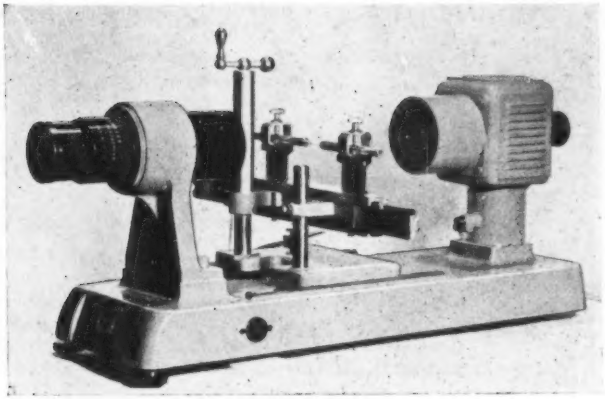


Fig. 16. The No. 3 Westminster Direct-viewing Horizontal Projector

The range of horizontal optical projectors has now been extended to include the No. 3 Westminster unit, seen in Fig. 16. This direct-viewing projector has a large field, so that areas up to 3 in. diameter can be observed, and large components can be accommodated. The type 3A projector comprises the basic unit with a manually-operated plain table, on which work-holding fixtures designed and constructed by the user can be mounted. The type 3B has a focusing slide, with remote control, also work slides and holding arrangements similar to those of the company's No. 2 projector.

The Baty No. 1 reflex projector, which is particularly suitable for general-purpose work, will also be demonstrated. This instrument has a work stage which is free from any obstruction, so that the operator can work in either a standing or sitting position.

Taylor & Jones, Ltd., Honley, near Huddersfield. Stand No. 163 (Gallery)

Among the exhibits on this stand will be selections from the company's range of patented B/47 expanding hand reamers. These reamers incorporate six helical cutting blades of high-speed steel, and are said to be particularly suitable for use in split bushes, and bushes with internal oil grooves. Also on view will be a selection from the B/33 range of expanding hand reamers, together with adjustable reamers which are provided with front and rear pilots to ensure accuracy of alignment. Certain types of the company's expanding hand reamers can be fitted with screw-on extension pilots, and a number of these items will be shown.

Inserted-blade type machine reamers with parallel and Morse taper shanks will also be exhibited, and it may be noted that the range includes shell reamers with parallel and tapered bores.

C. E. Johansson, Ltd., Southfields Road, Dunstable, Beds. Stand No. 47

This company's exhibits will be representative of the products of the Dunstable factory, which now include ground thread taps in high-speed steel, from 16 B.A. to 10 in. diameter, with both standard and special thread forms, and for various materials, also taps of special design to suit particular requirements, screw plug gauges, from 10 B.A. to 10 in., screw ring gauges, from 8 B.A. to 10 in.; plain plug gauges, thread rolling dies; Formator circular thread chasers; and miscellaneous thread ground components.

Manufacture of chaser dies for C.E.J. and Coventry type die-heads was recently begun, and the factory is now equipped to produce a complete range covering all die-head sizes.

Grey & Rushton (Precision Tools), Ltd., 93 Far Gosford Street, Coventry. Stand No. 129a (Gallery)

A complete range of vernier measuring instruments will be displayed on this company's stand, including vernier caliper gauges ranging in capacity from 6 in. to 6 ft., also knife-edge and open-scale caliper gauges. It may be noted that the 36- and 48-in. sizes of the standard pattern height gauges have been redesigned. They are

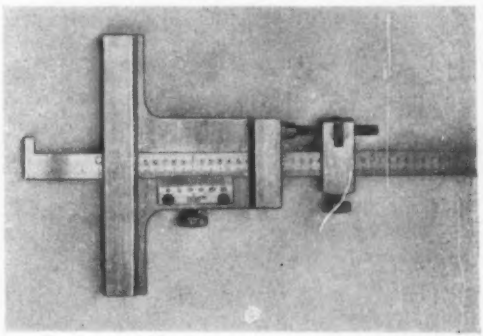


Fig. 17. Grey & Rushton Hook-type Gauge for Measuring the Depths of Recesses

now graduated in 0·05-in. divisions and millimetres, and incorporate vernier scales.

The company's H.D. vernier height gauge, with the patented Rotomatic movement, was described in MACHINERY, 84/1259—11/7/54, and the range of these instruments has been extended to include 36-, 40-, and 48-in. sizes. Component parts of the Rotomatic movement will also be displayed. Attention is drawn to the newly-developed hook-type depth-gauge shown in Fig. 17, which is intended for measuring the depths of recesses, and this gauge will be on view, in addition to other depth gauges with maximum capacities ranging from 3½ to 24 in.

Universal bevel protractors, sine bars, and hardened and ground V-blocks will also be shown, as representative of the company's wide selection of measuring equipment.

Fox & Offord, Ltd., Alma Street, Birmingham, 6. Stand No. 127 (Gallery)

The plastics injection mould seen in Fig. 18, which will be demonstrated by the company, as representative of their work in this field, produces three different components for a polythene sink-trap assembly. It has built-in hydraulic cylinders for core extraction, and is designed for fully-automatic operation, with electrical and mechanical interlocks to ensure that the various movements are correctly synchronized. Both the mould and cores are water-cooled.

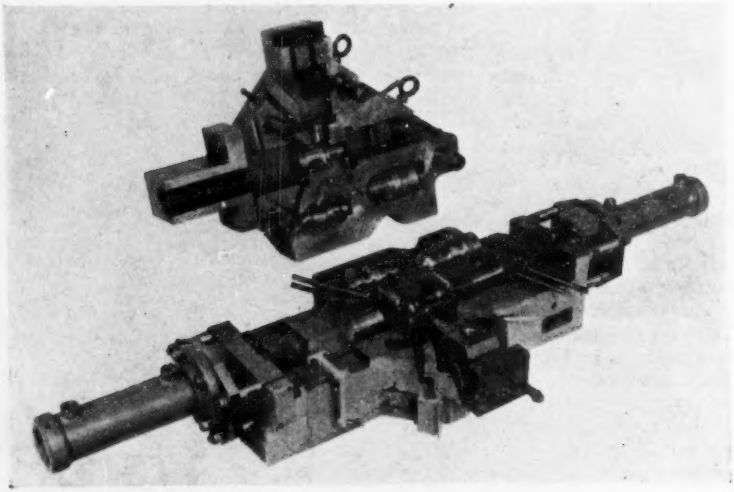


Fig. 18. Fox & Offord Plastics Injection Mould, with Hydraulically-operated Cores, for Producing Three Different Components

The design and production of die casting dies is another speciality, and examples of pressure and gravity dies for zinc, aluminium, and brass, will be on view. Other types of moulds, dies, and batch-produced assemblies will also be shown, and photographs and drawings will indicate the range of precision toolmaking work which is undertaken.

Rubert & Co., Ltd., Chapel Street, Stockport Road, Levenshulme, Manchester, 19. Stand No. 103 (Gallery)

This company will exhibit a variety of precision gauges and tools, including surface plates and tables, toolmakers' flats, cylindrical and standard engineers' squares, and surface-roughness comparison standards for the British and Continental systems of measurement. A new type of high-precision electrical comparator will be shown for the first time. Of the indicating type, it is suitable for automatic or semi-automatic inspection, and incorporates three signal lamps which show whether or not the workpiece that is being checked is within the prescribed tolerances.

A recently-introduced plastics compound, which will be displayed, provides for taking impressions and making replicas of workpieces for the determination of surface-finish, and for measuring errors of form, on areas that are not readily accessible. A new magnetoscope will also be demonstrated, which has been designed to detect minute amounts of magnetism in precision components. If such components are slightly magnetized, incorrect readings may be obtained when they are checked for surface finish with certain types of measuring instruments.

One of the principal exhibits on this stand will be the load/deflection test equipment seen in Fig. 10. Deflection of surface plates and tables, when subjected to loads during inspection operations, can influence significantly the accuracy of the test results. The revised B.S. 817/1957 specifies maximum deflections under load for various sizes of surface plates and tables, from 14 by 10 in. upwards, made from cast iron or granite. A

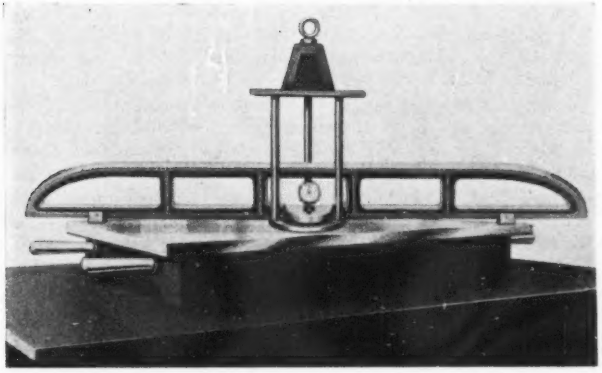


Fig. 19. Rubert Load/Deflection Test Equipment is Here Shown in Use for Determining the Distortion of a Surface Plate Subjected to a Specific Load

method of checking surface plates under load has been recommended by the N.P.L., and the Rubert equipment has been designed to permit users to check their own plates and tables at regular intervals.

The equipment comprises a rigid beam, which is supported on adjustable feet at each end, and incorporates a sensitive dial indicator. A third adjustable foot, offset in the mid-position along the beam, serves as a stabilizing support. Weights can be placed on a platform, which is independently mounted on pillars, in a central position along the beam. The pillars project upwards from a ring member, and the plunger of the dial indicator on the beam can engage the surface of the plate or table through the ring.

In addition to checking surface plates for deflection, the beam may be used as a comparator, and when employed for this purpose, the third foot is removed. The equipment may also be used for checking the deflection of machine-tool beds and tables. The deflection test equipment is available in three standard sizes, with beams 3, 6 and 10 ft. long, but larger units can be supplied to order.

Express Tools, Ltd., Roebuck Road, Chessington, Surrey. Stand No. 150 (Gallery)

The exhibits of this company will include press tools, jigs, fixtures, gauges, and special-purpose equipment for the production of components for calculating machines, typewriters, aero engines, motor cars, sewing machines and toys. Press tools with segmented and solid die members and form-ground punches will be displayed, also form-ground compacting dies for sintered metals. The jigs and fixtures exhibited will range from simple plate-type drill jigs, to intricate assembly fixtures and jigs for aircraft gas turbine blades. Complex form gauges, which are produced to very close tolerances, and air-operated fixtures, will also be shown.

Amar Tool & Gauge Co., Ltd., Chadwell Heath, Essex. Stand No. 53

An interchangeable press tool set, typical of the equipment made by this company, is shown in Fig. 20. Exhibits will also include other types of press tool components; leaf-, sandwich-, and box-type drill jigs; examples from the range of ground and honed plain-type ring gauges, which are made in various sizes up to a maximum of 2 in. diameter; and Amar plug gauges, which are available in single- and double-ended forms, with taper-lock connections between

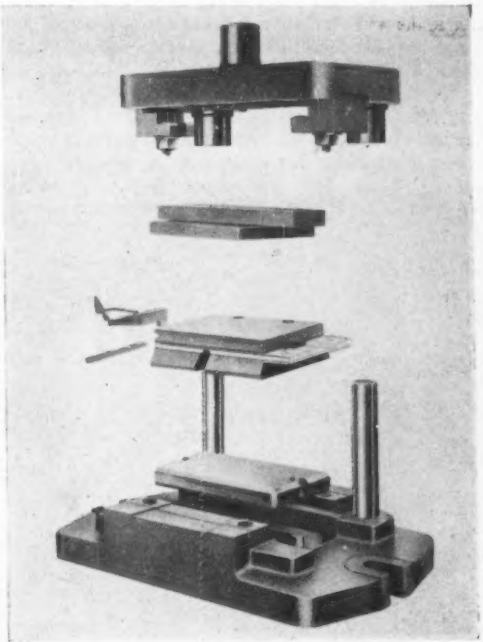


Fig. 20. Typical Amar Interchangeable Press Tool Set

the plugs and the handles, as recommended by the B.S.I.

Examples of production thread grinding, such as precision lead screws ground to customers' specifications, will be on view, as will thread milling cutters and screw plug gauges made from high-grade, oil-hardening, cast steel. Some of the items to be displayed have been treated by a low-temperature process developed by this company, and it is claimed that hardness can thus be increased by as much as four points Rockwell C above that obtained by normal heat-treatment. Gauges which have been treated in this manner will shortly be available commercially.

L. M. Van Moppes & Sons (Diamond Tools), Ltd., Basingstoke, Hants. Stand No. 55

The exhibits on this stand will indicate the wide range of applications for the company's diamond tools, and there will be demonstrations, on a Churchill NB surface grinder, of the use of Diatipt chisel-pointed diamonds for accurately truing formed grinding wheels. This machine will be equipped with a Diaform pantograph wheel-dressing attachment. The use of Diatipt tools for finish-machining non-ferrous metal and other materials will be demonstrated on a special-purpose lathe built by Small Electric Motors, Ltd., Churchfields Road, Beckenham, Kent.

A range of Diadex indexing diamond tool holders and attachments will be on view, some of which are shown in Fig. 21. A manually-operated crank-type diamond holder is seen at *A*, mounted in a special block for use on a surface grinding machine. The holder is indexed by means of the knurled nut, which also serves to lock it in the required position. Diamond tools having shanks to B.S.S. 2202:1953, of the straight-, face-, or cranked-type, can be held in the mounting block.

At *B* is shown a new mechanically-operated unit, intended for use on centreless grinders without hydraulic supply. The diamond is indexed, after each pass across the wheel face, by means of a plunger that strikes a suitably-mounted stop on the wheel guard. Diadex hydraulically-operated indexing tool holders, as seen at *C* and *D*, are intended for use on almost all types of hydraulically-operated grinding machines. These holders are employed in conjunction with special hydraulic valves, of the type seen at the top in the figure, and are operated directly from the hydraulic feed systems.

A range of Diatube masonry drills, which are available in sizes from ¾ to 12 in. diameter, will be demonstrated on a Diatube drill stand.

Among other items may be noted tools for use in connection with gear and thread grinding operations, and production form grinding by conventional methods; Dianyf blade tools; the new Diadust-impregnated roll truers; and Diadust lapping and grinding materials, including a new compound, and a special range of equipment, marketed under the name Dialap.

C. A. Gray, Ltd., Vernier Works, South Street, Bishop's Stortford, Herts. Stand No. 124 (Gallery)

A complete range of Ritefeel vernier gauges will be shown by this company, and a cut-away view of the patented measuring pressure control which is incorporated in all these instruments is given in Fig. 22. This mechanism is built into the sliding jaw of the gauge, and comprises a fine adjusting screw *A* to which is secured the ball carrier *B*. There are three equally-spaced balls in this member, which engage a dimpled track in the end face of the driver *C*, the latter being free to rotate on the outer end of the screw *A*. The parts *B* and *C* are urged together by the coil spring within the sleeve *D*, and the amount of pressure that is exerted by the spring

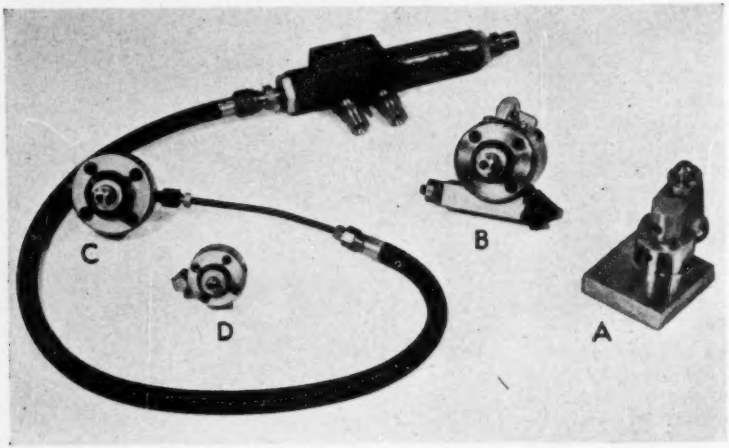


Fig. 21. Examples from the L. M. Van Moppes Range of Diadex Indexing Diamond Tool Holders and Attachments

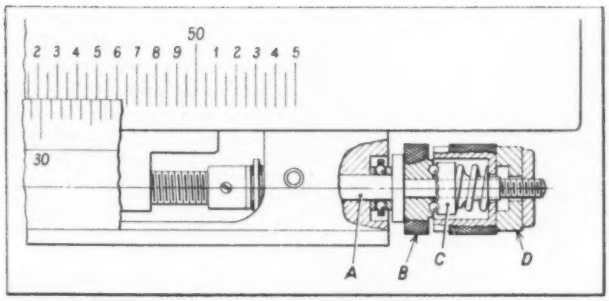


Fig. 22. Cut-away View of the Measuring Pressure Control which is Incorporated in the Gray Ritefeel Vernier Gauges

is pre-set by the maker. When the sliding jaw has been brought close to the part to be measured, by hand, the sleeve *D* is rotated, and drive is thereby transmitted to the fine adjusting screw *A*. The sliding jaw is thus brought into contact with the workpiece under a controlled pressure, which is determined by the setting of the spring, and when this pressure has been reached the balls ratchet round the face of the member *C*.

The Ritefeel gauges on view will include vernier calipers with capacities up to 72 in.; standard and box pattern height gauges, up to 48 in.; standard and hook-rule type depth gauges, up to 36 in.; and a range of gear tooth calipers covering sizes from 1 to 40 D.P., and 25 to ½ Module. Stellite-faced stick micrometers, in sets with overall lengths up to 50 ft. 7 in., will also be exhibited.

Demonstrations will be given of the Ritefeel boxing height gauge, which, with the aid of a supplementary vernier gauge, enables dimensions to be marked out on each side of a datum without the need for addition and subtraction.

M.P.J. Gauge and Tool Co., Ltd., Erdington, Birmingham, 24. Stand No.35

This company is producing air gauging equipment under licence from the Sheffield Corporation of America, and a number of Precisionaire gauging columns will be shown. The gauging assembly seen in Fig. 23 is for checking the parallelism of the gudgeon pin and crankshaft holes in connecting rods, and comprises a Precisionaire column unit and work fixture. The latter has two tungsten carbide spindles, one of which is stationary, while the other is mounted on a spring-loaded slide, and between them there is a supporting table for the workpiece. With the connecting rod in position, and depressed against a positive stop, the spring-loaded spindle moves sideways to contact one side of one hole, thus forcing the wall of the second hole against the other spindle. An air jet indicates the amount of sideways movement of the spring-loaded slide, and a reading for the centre distance of the two holes is obtained from the corresponding column of the Precisionaire unit. Provision is also made for the detection of any bending or twisting that may be present in the rod.

In addition to the unit just described, the company will exhibit basic Precisionaire instruments arranged for checking such dimensions or conditions as true or average inside or outside diameters, taper, out-of-roundness, squareness of bore axis to face, and concentricity. Some new designs of dial caliper gauges will be on view, also various internal and external types of "minor" caliper gauges, and roll caliper gauges with capacities ranging from 4 to 92 in. diameter. Reference may also be made to grinding gauges for measuring external diameters and widths between, and over, shoulders on workpieces, including a gauge which incorporates a micro-switch operated relay to ensure retraction of the grinding wheel when the required size has been obtained.

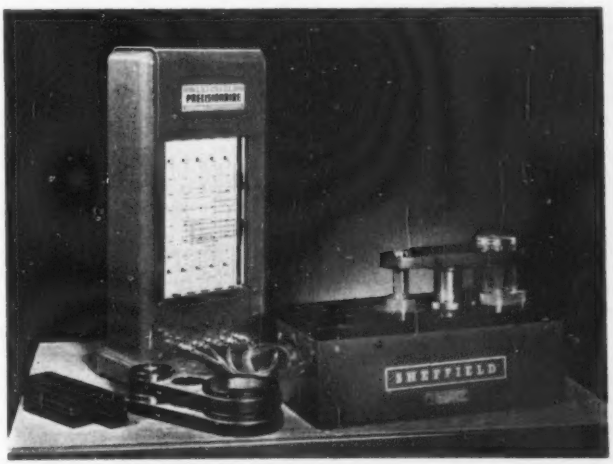


Fig. 23. M.P.J. Precisionaire Gauging Assembly for Checking Bore Centre Distance, and Twist of Connecting Rods

Among other items on this stand may be mentioned the company's type D and M dial snap gauges, the former covering diameters ranging from 0 to 42 in. and the latter from 0 to 4 in., and various types of dial stick gauges, with measuring capacities up to 48 in. The anvils of these latter gauges are arranged to retract, so that they may be used for measuring in recesses.

A. Capp & Son, Ltd., Verdict Gauge Works, Thames Road, Crayford, Kent. Stand No. 49

In addition to their range of Verdict indicators, this company will exhibit the Microball height gauge made by All Precision Engineering, Ltd, Kings Road, Horsham, Sussex. This height gauge was described in MACHINERY, 89/980—26 / 10 / 56, and it has a tubular column in which there is a stack of selected steel balls. A locating member incorporated in the cursor is brought into engagement with the balls through a slot in the column, by rotation of a knob, and in this way, settings in ½-in. increments are obtained. The scribing blade is finally adjusted by a built-in micrometer. As may be seen in the close-up view, Fig. 24, a dial indicator has now been fitted to the blade so that the height gauge can be employed as an independent measuring unit.

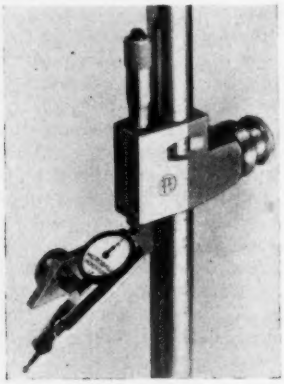


Fig. 24. The A.P.E. Microball Height Gauge Fitted with a Dial Indicator

The Brooke Tool Manufacturing Co., Ltd., Warwick Road, Greet, Birmingham 11. Stand No. 56

The complete range of Brooke unit heads will be shown on this stand, and there will be demonstrations of milling and drilling operations. These unit heads have already been described in MACHINERY, 87/1320—2/12/55, where details of the electro-mechanical and screw feed mechanisms were given. At that time, these heads were made in four sizes, namely UH1, UH2, UH3, and UH4, with driving motors of 2, 5, 12, and 15 h.p. respectively. Two further heads, known as the UH0 and the UHM4, have since been put into production. The former, with a 1-h.p. motor, has a maximum drilling capacity of ⅛ in. diameter in cast iron, or ⅝ in. diameter in steel, and, the latter, which is intended for milling operations, has a 20-h.p. motor, and a 50 series spindle nose arranged at right-angles to the longitudinal axis of the slideways. This head can be supplied in right- or left-hand forms, and with strokes of 12, 20 and 30 in. In common with the UH3 and UH4 heads, the type UHM4 head is driven by a built-in rotor/stator unit, and a separate 1½-h.p. motor is provided for the rapid traverse motion.

These unit heads can be used with either single or multi-spindle attachments for a variety of machining operations, including drilling, boring, reaming, counterboring, spot-facing, tapping, turning, and milling. In addition to making these unit heads, the Brooke Tool Machine, Jig, and Fixture Division undertakes the design and building of machines incorporating such heads, complete with bases, columns, indexing tables, and the necessary jigs, fixtures, and cutting tools.

A representative selection from the range of Cardinal high-speed steel milling cutters will be on view, together with metal-slitting saws, expanding and adjustable reamers, core drills, and high-speed twist drills up to a maximum diameter of 3¼ in. Attention may also be drawn to a display of specially-designed cutting tools, with carbide tips, or tipped blades.

Other items from the Cardinal range of equipment will include sets of counterbores, Mark 1 and 2 drill chucks, quick-change chucks and collets, tapping attachments, machine vices for toolroom use, and gear pumps for suds and oil.

George F. Clark & Sons (Toolmakers), Ltd., Swan Works, Colham Mill Road, West Drayton, Middx. Stand No. 130 (Gallery)

Examples from the wide range of accessories for power presses, which is made by this company, will be exhibited, and will include an improved spring-type automatic feed unit, and a large chopper unit. The recently-introduced Clark cam-type automatic press feed equipment will be demonstrated. This equipment is shown in Fig. 25, and in contrast to the other feed units made by the company, it is designed to be fitted to the press itself, and not to the press tool. Drive is taken through a telescopic shaft connected to the crankshaft of the press, and feeding can be carried out at any point during the cycle, the operation occupying 180 deg. of camshaft rotation. The length of material that is fed during each operating stroke can be varied from zero to 6 in. by means of the six interchangeable standard cams supplied with the unit, and, if necessary, special cams can be supplied. Final setting of the feeding length is obtained by adjust-

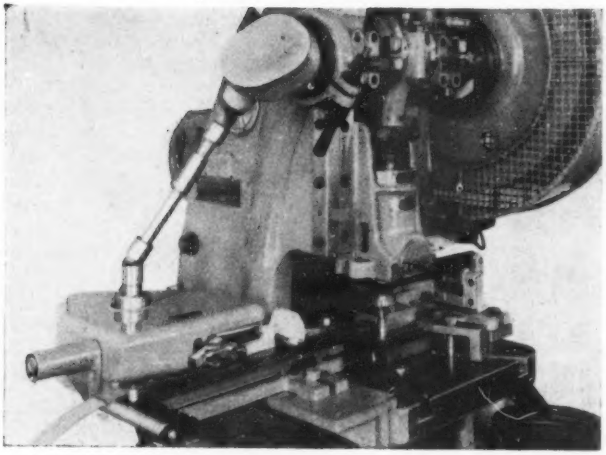


Fig. 25. The Recently-introduced Clark Automatic Cam-operated Unit for Feeding Strip Material into Press Tools

ment of a screw on the feed carriage. Both the feed carriage and the non-return mount are open fronted, so that strip up to 6 in. wide can be fed with standard equipment, and, by making simple modifications, virtually any width of material can be handled. The feed motion is derived from the rotation of the cam mechanism, and the feed carriage is returned by a compressed-air buffer.

The unit, which can readily be mounted on the press, measures 24 in. long (that is, across the bed of the press) and 20 in. wide. Its overall height is 6 in. and the material that is being fed is positioned 3 in. above the press bed.

Redman Tools & Products, Ltd., Gregory's Bank, Worcester. Stand No. 29

The display on this stand will be arranged to demonstrate the versatility and range of the Redman Unipierce and Unicrop systems of tooling for press-brakes, and for power- and hand-operated presses, also the Redman hydraulic Unipress equipment. Unipierce units may be employed for the production of round or irregularly shaped holes, also for performing piercing and dishing, piercing and countersinking, multiple piercing, and many other operations which are normally carried out with conventional press tools. The edges and corners of sheets can be cropped with Unicrop units, which can be supplied to cut any shape within the limits governed by their capacity. These units are positioned on the press with the aid of a template, let into a bolster-set on the bed. A thrust plate, secured to the ram, strikes the heads of the punches in the units on the down-stroke of the press, so that the necessary holes are pierced, and during the up-stroke, the workpiece is stripped from the punches by springs incorporated in the units. Since the units are not secured to the ram of the press, the accuracy of the machine is unimportant. The units can be re-positioned and used repeatedly, and the punches, dies and strippers are interchangeable. An 8-ft. press brake will be employed to demonstrate the units, and four operations will be performed simultaneously.

Dowty-Redman hydraulic springs can be fitted to conventional press tools to facilitate the stripping of workpieces which normally present difficulty. Hydraulic springs will be shown fitted to Redman Unipierce units engaged in the production of 1-in. diameter holes in ¾-in. plate.

The Redman hydraulic level-lift table, shown in Fig. 26, is designed to assist the feeding of steel sheets through slitting rolls, guillotines, or power presses, and will support loads up to 5 tons. Of fabricated construction, the base and table-top are joined together by a suitable linkage, so that when it is raised and lowered, the table remains level, even with an offset load. All the necessary electrical and hydraulic equipment is housed in the base, and the table is operated by a double-extension hydraulic ram, which is a self-contained unit with its own oil tank. The hydraulic pump is driven by a ¾-h.p. A.C. or D.C. motor, and arrange-

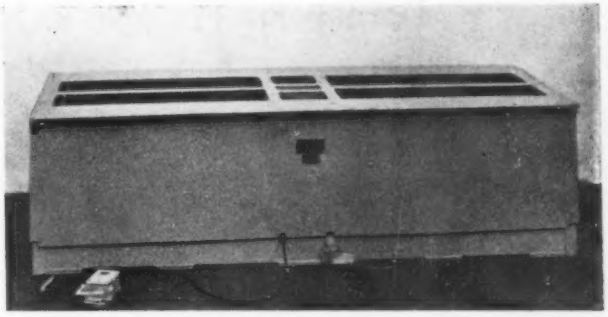


Fig. 26. The Redman Hydraulic Level-lift Table

ments for prevention of over-lift are incorporated.

Overall, the table-top measures 86 by 35¾ in., and it can be raised through 15¾ in. from its lowest position, which is 24¾ in. above floor level. The elevating motion is engaged by tripping a foot-switch, which is connected to the unit by a trailing cable so that it may be located in the most convenient position for the operator. A pedal on the unit provides for lowering the table rapidly, prior to re-loading. The weight of the complete unit is 20 cwt., and, if required, two tables can be connected, one being used for feeding, and the other, on the opposite side of the associated machine, to receive the finished products. The arrangement is such that as the feeding table is raised, the other table is lowered. Magnetic floaters can be fitted to separate the top sheets in a stack, to facilitate feeding.

Special-purpose machines, designed and manufactured by Redman Tools, will also be shown, including a hydraulic bumper-forming machine, capable of producing two motor car bumpers in 30 sec., and a hydraulic tube bending machine which will be demonstrated engaged in forming motor-car exhaust pipes.

Tooling and Equipment Engineers, Ltd., P.O. Box 67, Cambridge Street, Coventry. Stand No. 42

The Tandee taper measuring machine and linear dimension gauge, seen in Fig. 27, will be among the newly-developed equipment to be displayed on this stand. With the workpiece held horizontally between centres, measurements are made between hardened and ground steel balls, which have a limited amount of free movement until they are in contact with the workpiece and the micrometer anvil. This arrangement eliminates the need for supporting measuring rollers on slip gauges, and it is claimed that consistent repeat readings can be obtained by different operators.

Length standards and a micrometer head are provided in a trough, which extends along the front of the machine, for longitudinal measuring, and dial indicators graduated in 0·00005 in. divisions are incorporated for both length and diameter measurements. With the aid of a positive stop, taper reamers with odd or even numbers of straight or spiral flutes can be measured with this equipment.

In addition to measuring instruments, the company designs and constructs special purpose machines, jigs, press tools, and gravity dies.

B.S.A. Tools, Ltd., P.O. Box 232, Montgomery Street, Birmingham, 11. Stand No. 12G

Mention has already been made in MACHINERY, 92/834—11/4/58, of the recently-introduced Superland reamers and these tools will be on view as part of a selection from the extensive range of engineers' small tools and accessories made by the company. Other new items which will be displayed will include boxed sets of screwed shank tools, adjustable adapters for multi-spindle heads, and the range of Tru-Lok chucks which were described in detail in MACHINERY, 89/1470—28/12/56.

Twist drills, drill chucks, adapters, sleeves, and sockets will also be shown, together with arbors, machine vices, taps, dies, and tapping attachments. There will also be examples from the range of heavy-duty Snap-Lock limit switches, which can be supplied with a wide variety of operating levers. These switches are intended particularly for machine tool applications. Other items will include threading and serrating rolls, broaches, and oil and suds pumps.

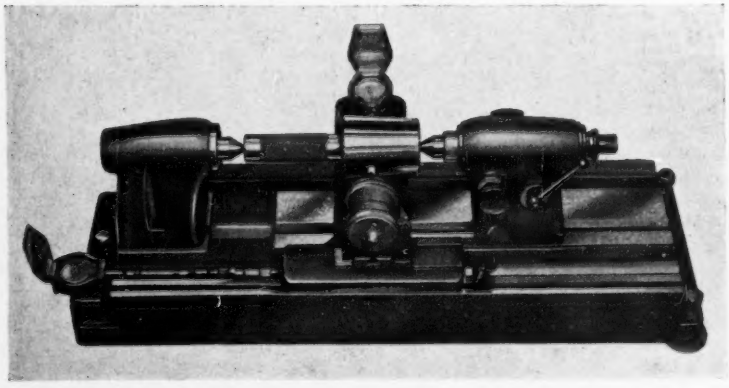


Fig. 27. Tandee Taper Measuring Machine and Linear Dimension Gauge

Of the non-opening type, the recently-introduced B.S.A.-Namco D.A. diehead illustrated in Fig. 28 has a capacity for cutting screw threads from 12 B.A. to ⅞-in. Whitworth, and is primarily intended for use on small automatics with rotating tool spindles which enable the die to be "backed off" the work. Comprising only two main parts, the head is fitted

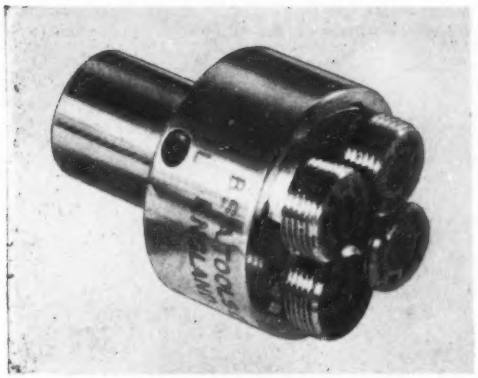


Fig. 28. B.S.A.-Namco Type D.A. Die Head

with circular chaser dies which can readily be removed for re-grinding. Two screws in the body enable the chasers to be adjusted simultaneously, according to the pitch diameter of the thread to be cut, without the need for removing the head. It is stated that, during tests under production conditions, the head has been free from vibration at spindle speeds of 5,000 to 6,000 r.p.m. The head is available with different shanks for Peterman, Tornos, Bechler and Wickman sliding headstock automatics.

J. L. Jameson, Ltd., West Street Works, Ewell, Surrey. Stand No. 15

As specialists in the design and building of special-purpose machine tools of all types, the majority of the products of this company do not readily lend themselves to exhibition. A large serration milling machine, which the firm has designed and built for C. A. Parsons, Ltd., will, however, be shown and there will be photographs and drawings of some of the many different types of machines which have been produced. Members of the design staff will be present on the stand to discuss problems with potential customers.

It may be noted that the heavy division of the company, which is located at Surbiton, Surrey, is equipped to handle castings weighing more than 20 tons.

The Truform Gauge Co., Ltd., Villa Road, Handsworth, Birmingham. Stand No. 48

This company specializes in the production of a wide and varied range of gauges and tools, including spline, serration, receiver, and built-up gauges, and representative examples will be exhibited, also true involute form serration plug and ring gauges. Among other items to be shown may be noted precision form-ground punches and dies, jigs, fixtures, press tools and moulds, and a number of profile-ground circular form tools. These tools are of cobalt high-speed steel, hardened and tempered to a minimum of 63 Rockwell C., and are finished on the latest types of optical profile grinding machines.

Notsa Engineering Co., Ltd., Lodge Works, Aston-on-Trent. Stand No. 105 (Gallery)

To draw attention to the facilities available for checking, to close limits, parts produced in the works, also items submitted by customers, a Taylor, Taylor & Hobson Talyrond, and a Société Genevoise MU-250 measuring machine, have been selected from the equipment of the company's standards room for demonstration on the stand. Other exhibits will include Notsa ball reference pins and segmental grinding heads.

Reference may also be made to the recently-introduced Rotatilt adjustable table which is seen in Fig. 29. It enables workpieces to be presented in a convenient position to facilitate fitting and assembly operations. Alternatively, it can be set level with the table of a machine for supporting long parts while cutting operations are in progress. The 18- by 18-in. T-slotted table can be turned through 360 deg. in the plane of its working

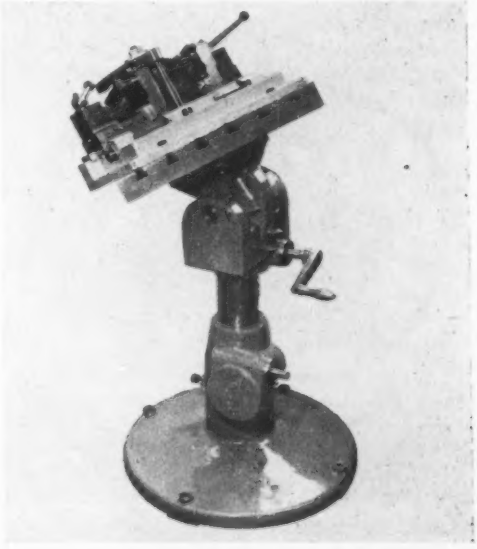


Fig. 29. Rotatilt Adjustable Work-Table

surface, tilted through 90 deg., and adjusted vertically by means of a detachable crank and gearing. Maximum and minimum heights of 35 and 29 in. are obtainable from the floor to the working surface of the table. The substantial cast iron base has four holes which will take either fixing bolts or jacking screws.

The firm also undertakes the production of jigs, fixtures, and special purpose machines, and the calibration of slip gauges.

Belsize Engineering Co., Ltd., 6 Whitcher Place, London, N.W.1. Stand No. 132 (Gallery)

In addition to a representative selection of jigs, fixtures and press tools, this company will exhibit the large checking fixture seen in Fig. 30. This fixture, which is shown by courtesy of the de Havilland Engine Co., Ltd., is for the air intake casting of the Gyron Junior jet propulsion unit, and serves to check more than 100 contours and alignments, both external and internal, also the positions of tooling holes for subsequent machining operations.

As may be seen, the checking fixture is trunnion-mounted, and is positioned by means of the large hand-wheel. A capstan-type clamp is provided between two of the spokes of this wheel, for locking the fixture in the required angular position, and it may be noted that the entire assembly consists of more than 1,000 parts.

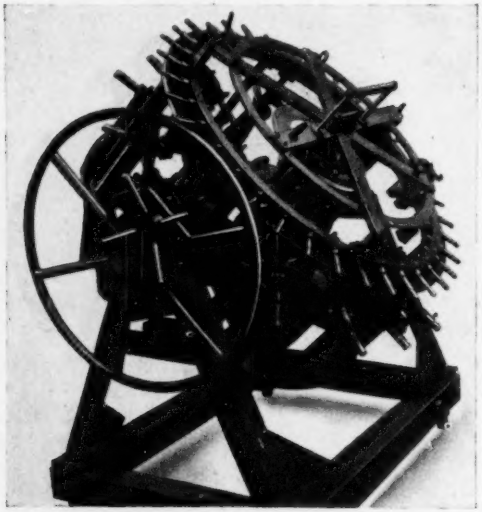


Fig. 30. Trunnion-mounted Fixture Made by Belsize Engineering for Checking an Air Intake Casting for a Jet-Propulsion Unit

Coventry Gauge & Tool Co., Ltd., Fletchamstead Highway, Coventry. Stand No. 57

Several additions to the Matrix range of precision measuring equipment will be displayed by this company.

Based on experimental equipment developed by the Mechanical and Engineering Research

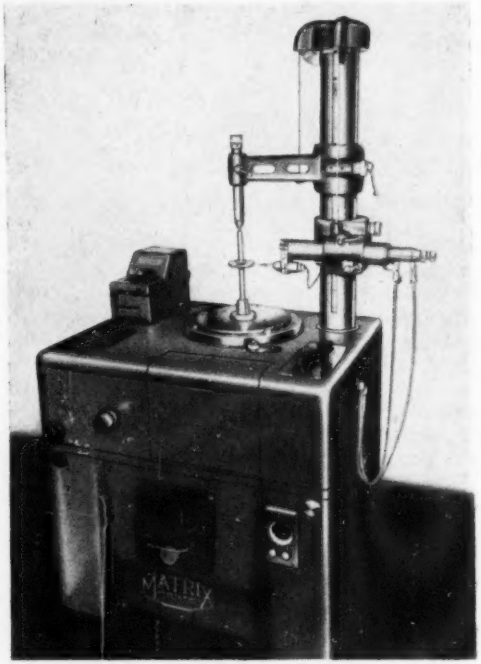


Fig. 31. Matrix Machine for Checking Gears for Tooth Spacing and Concentricity

Laboratory, and incorporating various design improvements, the recently-introduced machine illustrated in Fig. 31 is intended for checking gears, up to 12 in. diameter, for tooth spacing and concentricity, to a high degree of accuracy, on an entirely automatic cycle. It will check gears with numbers of teeth down to 6, the maximum number being limited only by the size of probe that can be fitted to the measuring head.

Accurate indexing of the work table is obtained by a 14-in. long sine arm, angular setting of which is obtained by slip gauges. The sine arm is operated pneumatically and a cushioning arrangement is incorporated to ensure that accuracy of indexing is obtained consistently. Interlocks

are provided which ensure that the working cycle cannot be started until all controls are correctly set.

At the end of each indexing motion, the measuring head is advanced by an air cylinder to bring the probe into contact with one flank of a gear tooth, and a record is then obtained on a paper strip by means of a Taylor, Taylor & Hobson electronic unit. The amplifier for this unit is housed in the base. The cycle time for this sequence of operations ranges from 12 to 20 sec. according to the size of gear being checked. When all the teeth on the gear, or a pre-set number, have been checked, the machine is stopped automatically.

Although it is recommended that the workpiece should be mounted on the table to reduce errors in setting, a centre can be fitted, and there is an adjustable tailstock for holding mandrels up to 24 in. long. Carried by a spindle which turns in precision angular contact ball bearings, the table can be adjusted accurately in the horizontal plane by four small wedges, to facilitate setting the workpiece accurately concentric.

The tailstock centre is mounted in a spherical bearing, and, upon release of a knob-operated clamp, it can be swivelled in any direction for setting a mandrel accurately vertical. This setting can be checked by bringing the probe into contact with the mandrel at different levels. The measuring head has a vertical adjustment of 15 in. on the cylindrical column, and the minimum distance between the probe and work table is 1 in.

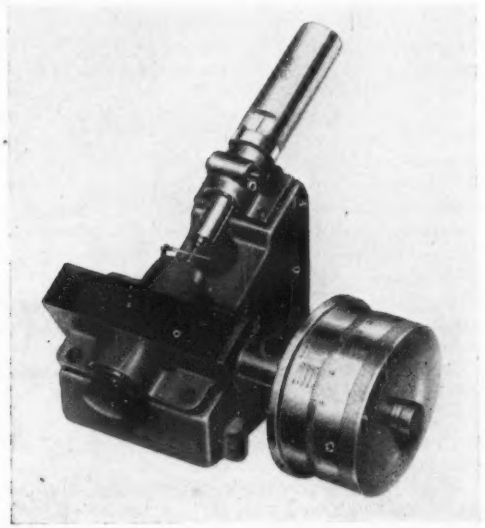


Fig. 32. Matrix Small-capacity High Precision Comparator

Another new product to be shown is the precision comparator illustrated in Fig. 32, which is based on an instrument developed by the National Physical Laboratory for checking small cylindrical parts to an exceptionally high degree of accuracy. This comparator incorporates a wedge-shaped slide of tungsten carbide with lapped surfaces, which transmits motion at right angles with a reduction in the ratio of 10 to 1, between the spindle of a large-diameter micrometer and a measuring plunger. Since the micrometer gives readings to 0·0001 in., workpieces can be checked to an accuracy of 0·00001 in. Measurements can be made to a still higher degree of accuracy by estimating readings. Another feature of the design is that the effect of any cyclic or progressive errors in the micrometer screw are reduced (in the ratio of 10:1) by the wedge-shaped slide.

The work is interposed between the measuring plunger and the plunger of a fiducial indicator, which has a magnification of about 1,000×, and ensures that constant contact pressure is applied to the piece while checking is in progress. This indicator can be adjusted axially to accommodate workpieces of different diameters up to 1 in. The measuring head and fiducial indicator are set at an angle of 30 deg. to the base so that they are presented in a convenient position for operation.

New equipment on view will also include a 3-dimensional measuring machine which has been developed from the Matrix No. 59 jig borer, an involute measuring machine, and a circular tilting work table of unusual design for setting compound angles. Details of these exhibits will be published in a forthcoming issue of MACHINERY.

S. L. Van Moppes, Ltd., St. Andrews House, 32/34 Holborn Viaduct, London, E.C.1. Stand No. 100 (Gallery)

The selection from this company's products will include resinoid- and metal-bonded diamond impregnated wheels, wheel dressing tools, impregnated hand laps, and loose diamonds. There will also be shaped tools for boring and turning, and chisel-type tools.

British Indicators, Ltd., Sutton Road, St. Albans, Herts. Stand No. 59

To demonstrate the versatility of the John Bull Ten-Fifty Checkmaster bench comparator, it will be used in a number of different gauging set-ups, for such applications as the roll testing of gears, and the simultaneous checking of internal and external dimensions, and concentricity. This

comparator, which was described in MACHINERY, 90/594—15/3/57, incorporates a fixed table and an adjacent slide, both of which have T-slotted working surfaces for the reception of tongue-shaped anvils. The slide and worktable are urged apart by a spring, and the anvils are available in a variety of shapes and sizes to engage with plain, splined, or keywayed bores, for example, when internal surfaces are to be measured. Alternatively, the instrument can be set so that the slide and worktable are urged towards each other by the spring, and then external surfaces can be measured.

In addition to the components already mentioned, this instrument is suitable for checking ball race tracks, screw threads, and fir-tree and dovetail section turbine blade roots.

A dial-gauge testing machine has been developed for the continuous checking of the accuracy of John Bull dial indicators. Basically, this instrument comprises a revolving table, to which the body of the dial indicator is secured, and a sine bar which can be traversed at a constant rate. When the table portion is turned, the body of the indicator is carried with it, and the sine bar, which is in contact with the measuring plunger of the indicator, is traversed at a rate calculated to keep the indicator pointer stationary in space.

The range of small-bore measuring equipment made by this company has been redesigned, to incorporate quick-adjusting contact points, and it is stated that this development has obviated the need for spacers when setting the gauges. Other exhibits will include the newly-introduced type 220 dial snap gauge, which will be demonstrated on a variety of applications, including the checking of threads and undercuts, and a small comparator, complete with a range of gauges, for checking a number of petroleum pipe line elements, to the specification of the American Petroleum Institute.

Moore & Wright (Sheffield), Ltd., Norton Lane, Sheffield, 8. Stand No. 16

This company will show an extensive range of measuring tools, including micrometers, squares, bevel protractors, and depth gauges. Of particular interest will be a display of the measuring tools which are made for the National Institute for the Blind, and similar organizations overseas. These tools, which were described in MACHINERY, 85/351—13/8/54, incorporate Braille markings, and the rectangular-pillar height gauge included in this range will give readings direct to 0·001 in., or by vernier to 0·0002 in. There are two arms on the pillar of this gauge, the upper carrying the micrometer drum, and the lower, a knife edge register. Initial positioning of the upper arm is effected by means of a number of V-shaped slots in the rear edge of the beam, which are spaced at 1-in. intervals, and the decimal portion of an inch is obtained by the micrometer head.

An alternative design of Braille-reading height gauge is available, which has a cylindrical pillar with an accurately-ground spiral groove of ½-in. pitch extending along its length. The micrometer head incorporates three drums, and the uppermost drum has a nut engaging with the groove in the pillar. By rotating this drum, the micrometer head is set for initial position, and a system of gearing within the head turns the lowest drum to record this position, in terms of whole inches and half inches, against a datum mark on the non-rotating middle drum. It may be noted that the range of Braille-reading tools made by this company also includes micrometers and bevel protractors.

Specially-designed tools, for taking measurements in restricted and difficult positions, will be on view, also a number of tools which have been sectioned to show the construction.

Hardinge Machine Tools, Ltd., Hampton Road West, Hanworth, Feltham Middx. Stand No. 159 (Gallery)

Four newly-introduced items will be shown on this stand, including a range of precision expanding collets for components which must be located from an internal surface. These collets, which are employed in conjunction with a special opening and closing unit, are available with bore sizes from ¾ to 3 in., and will be demonstrated on a high-speed, second-operation machine.

Designed to reduce the amount of overhang, the new "speed" collet chuck for centre lathes is available in three sizes, namely, 1⅜, 1½, and 1¾ in.

A collet indexing fixture, which will also be on view, is made in various forms for production, toolroom, and inspection purposes. This unit can be supplied complete with an indexing head, tailstock and sub-base, and is suitable for use on a bench or a machine table. The indexing head can be used independently, and the production unit can be mounted horizontally or vertically.

For the accurate length location of second operation work, the company make a universal collet stop, complete with spring ejector.

Demonstrations will be given, on a high-speed precision lathe, of a new Swiss-made quick-change precision tool-post, which can be supplied in various forms for turning, facing, drilling, reaming, boring, and screwcutting operations.

Other items will include the range of Suregrip master collets, circular form, and parting-off tools, and step-chucks with diameter capacities from 2 to 6 in. The latter will be demonstrated on a precision centre lathe.

Power Press Exhibits

Joseph Rhodes & Sons, Ltd., Grove Ironworks, Wakefield. Stand No. 25

The exhibits of this company will include the machine shown in Fig. 33. Known as a projection blanking press, it is rated at 60 tons, and is so designed that, during blanking operations, the top die never enters the bottom die. The frame is prestressed in compression to a value considerably above the recommended maximum loading so that the tensile stresses imposed during the blanking operation merely tend to relieve the load, and extension is kept to a minimum. Air cylinders are employed to overbalance the downward moving parts in the ratio of 4:1, so that the thrust faces are maintained in contact, and there are no clearances to be taken up before blanking can occur. Similarly, overrun of the ram, and consequent entry of the punch into the die, is prevented. To facilitate setting, stop blocks can be provided on the punch and die, which are ground level with the cutting edges. This press is fitted with a double set of automatic feed rolls.

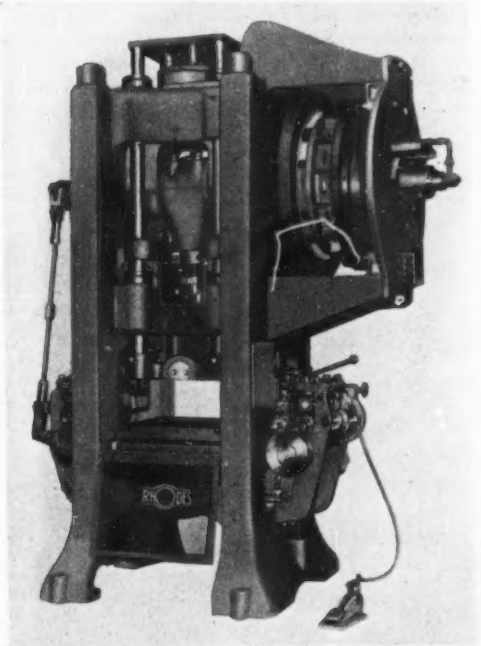


Fig. 33. Rhodes 60-ton Projection Blanking Press

Also on view will be a 70-ton open-front press—the largest of a new range of inclinable machines—and a 75-ton double-sided press which will be demonstrated fitted with dies for an aluminium saucepan body. This part, of 7 in. diameter by 5 in. deep, will be produced with the aid of the company's patented Simplex drawing mechanism. Demonstrations will also be given on a high speed blanking press, running at 450 strokes per min., and a stagger-feed press will be seen blanking lids and bottoms for canisters from standard tinplate sheets of 36 by 24 in. With this feed arrangement, considerable savings in material are obtained, and it is unnecesary to cut the sheet into strips.

Hordern, Mason & Edwards, Ltd., Kingsbury Road, Birmingham, 24. Stand No. 32

A total of nine power presses will be exhibited on this stand, and particular attention is drawn to the new toggle-action coining press shown in Fig. 34. This press, which has a 2¾-in. stroke, and develops a force of 360 tons, is driven by a 5-h.p. motor, and the operating speed is 45 strokes per min. The frame is of welded construction and is stress relieved, and a feature of the design is that the toggle mechanism is located beneath the table, the crankshaft gearing and clutch being housed at the rear near the floor. From the clutch shaft, which carries a flywheel incorporating an H.M.E. air clutch and an air-released band brake, drive is transmitted through helical gearing to a crankshaft, and thence through an approximately horizontal connecting rod to the toggle. At the upper end, the toggle bears against the underside of the table, and the lower end is connected to the rectangular slide.

With this arrangement, it is claimed, deflection of the frame is negligible, since it is stressed only in compression, and the low centre of gravity tends to reduce vibration. The slideways are long and narrow so that good alignment is ensured, and the slide, which is the load bearing member, is of welded steel plate construction and does not require shrunk-on tie rods. Elongation of the slide under load can be predicted and easily measured, and a dial indicator is provided so that the operator can check the force which is exerted at each stroke.

The upper tool is secured in a plain hole by means of a locking set screw, and there are four ¾-in. T-slots in the bed for clamping the die. Pro-

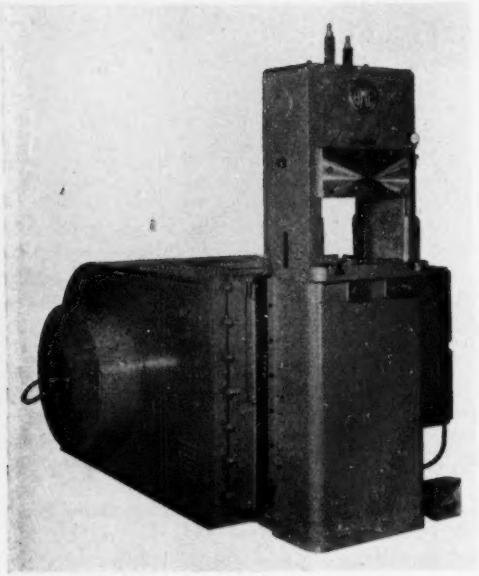


Fig. 34. H.M.E. 360-ton Toggle-action Coining Press which has a 2¼-in. Stroke, and Operating Speeds up to 360 Strokes per min.

vision is made by means of a wedge operated by a handwheel, for independent adjustment of the top tool through a distance of ⅝ in. With this member adjusted fully upwards, and the slide at the bottom of its stroke, the height available for tools is 11 in., and the T-slotted bed area measures 17 in. wide by 19½ in. from front to back. A selector switch provides for continuous or single stroke operation, or inching, and alternative control of the non-repeat action is provided by a shrouded pedal. The base of the machine forms a reservoir from which oil is pumped to the knuckle joints and other bearing surfaces.

Among the other presses to be shown may be noted the H.M.E., 100-ton, Rigispeed, which is one of a range with strokes from 1 to 3½ in., and operating speeds from 85 to 250 strokes per min. All these presses can be arranged for strip feeding, and the range is shortly to be extended by the introduction of 45- and 70-ton sizes. The type DCP.5, 150-ton press, which will also be on view, incorporates a mechanism whereby the stroke can be changed quickly within a range of 1 to 6 in.

The remainder of the presses exhibited will be of the open-front type, with capacities ranging from 20 to 100 tons.

Rockwell Machine Tool Co., Ltd., Welsh Harp, Edgware Road, London, N.W.2. Stand No. 31

The British-built U.S. Multi-slide machines, types No. 28 and 35, will be exhibited for the first time in this country. Machines of these two sizes are being made under licence from the U.S. Tool Co., Inc., New Jersey, U.S.A., and it may be noted that the agreement also provides for the production of tooling. Machines can, therefore, be supplied with tools for one or more components, and as they are being made to American standards, interchangeability is ensured.

Designed primarily for the production of formed stampings to close tolerances, from coiled stock, these machines can handle intricate parts at high rates of output, as required for example by the motor vehicle, office machinery, and electrical industries. The type No. 28 machine is shown in the accompanying Fig. 35, and, like the type

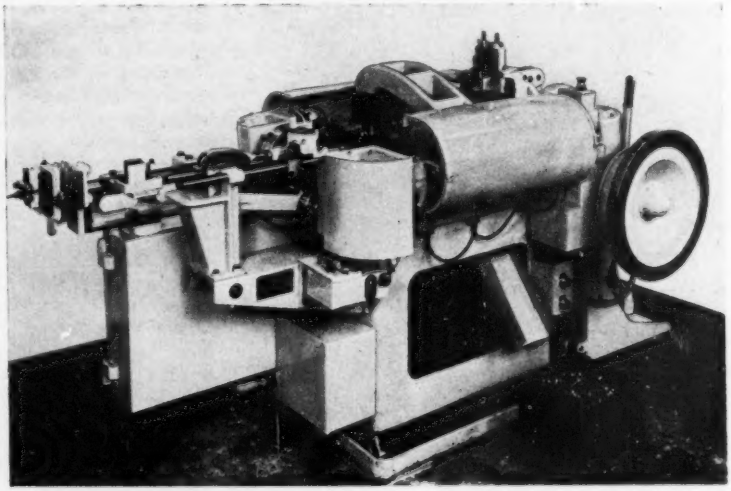


Fig. 35. British-built Type No. 28 U.S. Multi-slide Machine, which is being Exhibited by Rockwell Machine Tool Co., Ltd.

No. 35, comprises a standard basic unit equipped with an automatic feed mechanism; a stock straightener and check; one horizontal press head, which can be utilized for such operations as piercing, trimming, embossing, swaging, or blanking; four horizontal forming slides, disposed at 90 deg.; and a vertically-acting stripper mechanism. The press head is cam-operated, and two or three heads can be provided, if required, so that when a considerable amount of cutting or trimming is involved, the operations can be spaced, to reduce tool maintenance and obtain increased die life.

A variable-speed drive is employed, with a motor of 2 to 10 h.p., depending on the size of the machine and the operations to be performed, and an electrically-operated, limit switch controlled, brake is incorporated so that, in the event of a mis-feed, the machine can be stopped instantly. A number of standard auxiliary units is available for mounting on the machines, including a cam-operated rear slide, which can be used for operations which require pressure in a direction opposed to that of the normal press heads; a 100-ton toggle press, which can be fitted in place of one of the normal press heads, to provide for heavy-duty swaging, embossing, coining, or counter-sinking operations; a rear positive knock-out attachment; a cut-off slide; and a blank hold-down unit.

Another exhibit on this stand will be the Vickers-built type SD 2250 British Clearing press of 12-in. stroke, which is rated at 250 tons, and has a bed surface measuring 44 by 48 in., and an operating speed of 16 strokes per min. All the electrical and air connections for this press are arranged in manifolds, so that there are no external wires or pipes, and it is fitted with the Clearing automatic Clear-Flo lubrication system.

In connection with the British-built U.S. Multi-slide machines, mentioned earlier, a selection from the wide range of British-built U.S. press room equipment will be shown, including special feeds for long lengths of material, precision slide feeds, and plain and power-operated straightening machines, also stock reels and cradles, stock oilers and wipers, and scrap cutters.

E. W. Bliss (England), Ltd., City Road, Derby. Stand No. 30

In Fig. 36 is shown the newly-introduced 25-ton inclinable flywheel press which will be exhibited on this stand. The machine is the smallest of a new range of open-fronted presses, and 35- and 45-ton sizes will also be on view. The machine illustrated is driven by a 2-h.p. motor, mounted at the rear of the machine to reduce the amount of head room required, and has an operating speed of 135 strokes per min. A new

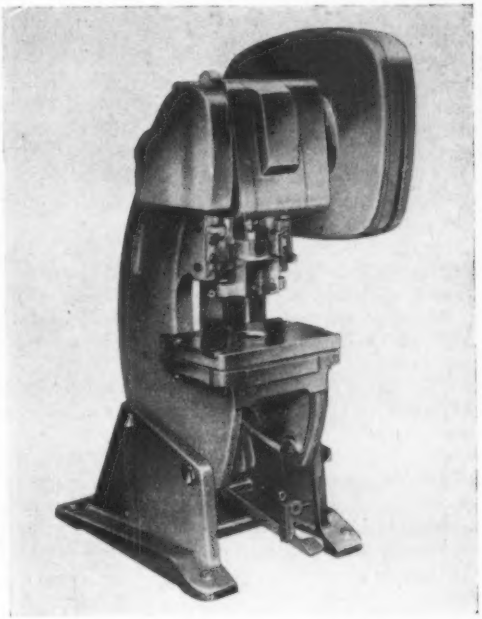


Fig. 36. Bliss 25-ton Inclinable Flywheel Press

type of adjustable stroke mechanism is incorporated, and on the 25-ton press the stroke can be varied from a minimum of ½ in. to a maximum of 3½ in., in six steps. There is also an adjustment of 2½ in. for the slide. The three machines on view have frame openings with widths of 10¾, 13½, and 14½ in., and the corresponding slide face measurements are 7¾ by 6½, 8¼ by 7½, and 9¾ by 9 in. With the stroke down, and the slide adjustment up, the distances from the slide faces to the bed surfaces are 9, 10, and 11½ in. Semi-automatic one-shot lubrication is provided as part of the standard equipment on all the machines in this range. A cam-operated hand-brake is incorporated, which stops the press at the top dead centre position, and this brake, together with the flywheel, is totally-enclosed by fibre-glass guards. The press legs are so designed that front tie rods are not required, and, in consequence, work pans can be removed and replaced more easily.

The No. 1831 high-speed automatic strip feed press, described in MACHINERY, 88/1197—22/6/56, will be demonstrated, producing can ends at a rate of 600 per min., and will be fitted with double curling and stacking attachments.

The No. 21½ F 50-ton foil press, which will also be shown, has been specially-designed to meet the

growing demand for foil products, and is particularly intended for producing such components as aluminium-foil pie and cake plates. This press, which operates at speeds up to 120 strokes per min., has a single roll-feed mounted between the uprights, so that the foil is taken directly from a coil and fed forward across the die area. The feed rolls are 24½ in. wide, and the 18 in. feed stroke enables large single dies or small multiple dies to be employed.

Another exhibit will be the No. 25A, 600-ton (short) straight column, knuckle-joint, embossing press, which has an operating speed of 33 strokes per min. This press is of 4-piece tie-rod construction, the bed, crown, and uprights being weld-fabricated and stress-relieved.

The No. 1100 scroll shear, for producing cut strips for can ends, bottle caps, and similiar components, will also be on view. This machine, which operates at 90 to 120 strokes per min., and will admit 36-in. square plain, or lithographed, sheets, is arranged for fully-automatic operation, and can be equipped with magnetic bars for handling ferrous, and mechanical feed bars for non-ferrous, sheets.

Cowlishaw, Walker & Co., Ltd., Biddulph, Stoke-on-Trent. Stand No. 20

In Fig. 37 is shown the 250-ton, type I.D.8S press, which has recently been developed by the company, and the basically-similar 300-ton machine will be demonstrated. The frame is of fabricated steel construction, stress-relieved, and the transmission is housed within the crown. Admitting 42 in. between the sides, this press has an 8-in. stroke, and is driven by a 30-h.p. motor, through an electro-pneumatic clutch-brake unit of the company's design, at a speed of 25 strokes per min. A separate 3-h.p. motor is provided for the slide adjustment. Normally, a fixed guard is provided at the rear of the press, and a vertical guard at the front, which is controlled by the operating button, and is interlocked with the safety control circuit. Both these guards have been removed from the machine illustrated, for clarity.

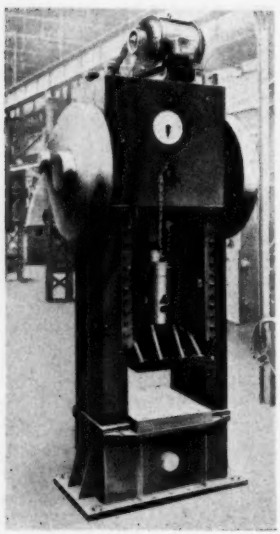


Fig. 37. Cowlishaw, Walker 250-ton, Type I.D.8S Press

The electrical control gear is contained within a separate cubicle, and a master push-button station is mounted on one upright. At the exhibition, compressed air for the machine will be supplied by a Bullows 20SR901 Hydrovane rotary compressor.

Taylor & Challen, Ltd., Constitution Hill, Birmingham, 19. Stand No. 28

This company is exhibiting a number of high-speed and mechanically-fed blanking, notching, and drawing presses, also a screw press and a multi-action vice press for hot-forging operations on cored brass and light alloy components. The type 1881 50-ton blanking press incorporates an FU (London), Ltd., variable speed unit which

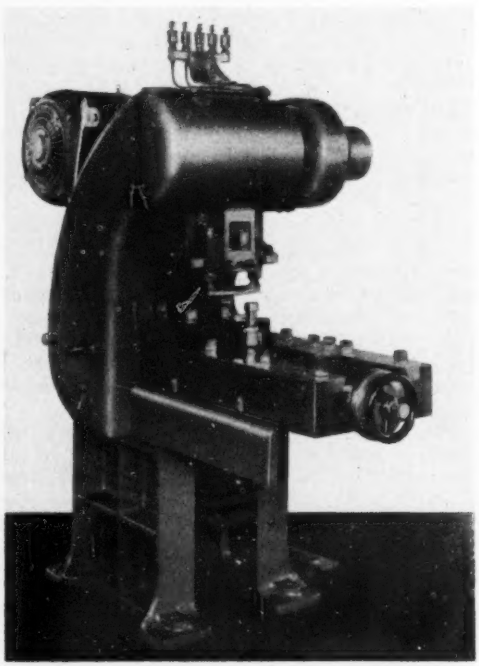


Fig. 38. Taylor & Challen Type 1901 High-speed Notching Press

provides a speed range of 65 to 400 strokes per min., and will admit a maximum strip width of 8 in. This press has a 14- by 14-in. slide face to accommodate multiple tools for cutting two or more blanks per stroke. Attention is drawn to the type 1901 press seen in Fig. 38, which will also be exhibited. This high-speed machine is intended for notching rotor laminations at rates up to 1,000 strokes per min., and will admit parts with notch pitch circle diameters ranging from 3½ to 17 in. The indexing mechanism on this machine has been designed to maintain a high accuracy of pitch spacing, and micro-adjustments are incorporated for positioning the saddle.

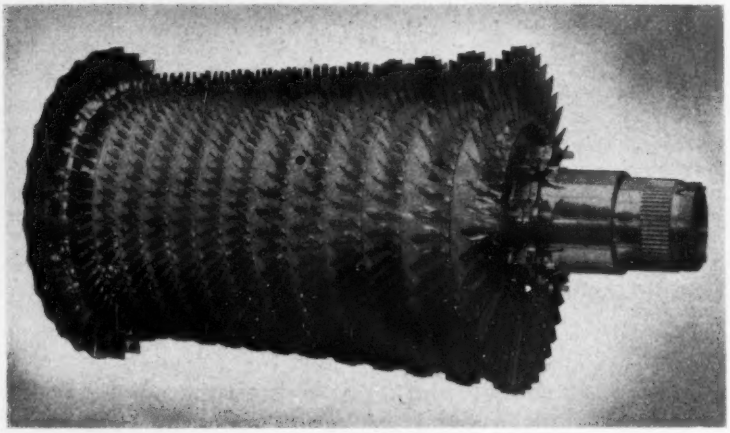
Two of the presses to be shown on this stand will be arranged for mechanical feeding and ejecting, namely the type 1507 horizontal press, which will draw cups up to 2½ in. diameter by 9¾ in. long, and the double-action type 1776 press, which will feed blanks up to 11 in. diameter, and has a punch stroke of 10 in. As an example of machines for hot brass open-die pressing work, the company will show a type 1615 high-speed friction screw press, which has an 18-in. stroke and provides an impact force up to 200 tons.

For hot cored pressings made in vice-type dies, there will be a type 1878 multi-action press, which is intended for the production of pillar taps, and similar components, in brass and light alloys. This 100-ton machine has a main punch stroke of 8 in., and the two side punches have strokes of 1⅛ and 5 in. Other exhibits on this stand will include the type 1632 geared, open-front press, which is rated at 15 tons without tie-bars, and will be set up for clipping brass pressings. This machine will cut mild steel blanks 9 in. diameter by 0·028 in. thick, or 2 in. diameter by ⅛ in. thick, and can be arranged for use in the inclined position.

Index to Gauge and Tool Exhibitors whose Products are Reviewed in the Preceding Pages

Machining Blades for Gas Turbine Units

Methods Employed by the B.R.D. Co., Ltd., Aldridge, Staffs.



The B.R.D. Company, Limited, a member of the Guest, Keen & Nettlefolds group of companies, was established in 1947, and now occupies a large new factory on the Redhouse industrial estate, at Aldridge, Staffordshire. This factory covers an area of nearly 200,000 sq. ft., and is capable of being enlarged to at least twice its present size. Towards the end of 1951, it became apparent that the rearmament programme would involve the production of large numbers of gas turbine blades, and that these blades could not be made by precision forging methods, due to lack of capacity. The activities of the company were then considerably expanded in order to exploit fully the new and revolutionary methods of machining blades from oversize forgings, which the firm had been developing since its inception.

Negotiations with the Ministry of Supply led to the construction of the new factory which is at present occupied by the company, and operations were started there in the autumn of 1953. During subsequent years, large numbers of blades were made for such well-known engines as the Avon and the Sapphire, and although requirements have since been considerably reduced, production is still at a high level. Some of the specialized methods developed by the company will be discussed later in this series, and the present article will be confined to the production methods and operations used for precision forged blades. Before passing on to the subject of blade production, however, it may be of interest to consider briefly some of the other activities of the company.

Although the company was initially interested mainly in blade manufacture, the management was sufficiently far-sighted to realize that it was unwise to concentrate entirely on a single product, and several other divisions have been established during recent years. What is probably the most important of these divisions is now engaged in machining several thousands of crankshafts per month, and is supplying a number of important engine manufacturers. Among the plant installed for crankshaft production may be noted +GF+ (Vaughan Associates, Ltd.) copy-turning lathes, and Maximatic [Drummond-Asquith (Sales), Ltd.] journal and pin turning machines, of similar design to those described in MACHINERY, 91/348—16/8/57.

In addition, there are batteries of Newall (Newall Group Sales, Ltd.), journal and pin grinding machines which are served by Martonair monorail hoist systems, and high-frequency induction hardening equipment supplied by A.E.G.-Elotherm, G.m.b.H. (J. L. Turner, 404 Fulwood Road, Sheffield, 10). This equipment may be fitted with a range of different heads to enable bearing surfaces of a wide variety of lengths and diameters to be hardened, and is generally similar to that described in MACHINERY, 91/1207—22/11/57, in connection with the European Machine Tool Exhibition at Hanover. There is also a Radyne fully-automatic induction-hardening plant, supplied by Radio Heaters, Ltd., details of which were published in MACHINERY, 89/1134—16/11/56. From these brief references it will be apparent that the methods employed, although conventional,

are up to date and are well adapted to the production of a number of different shafts with a high standard of efficiency.

Until a large contract was recently completed, the company also operated a largely automatic, conveyorized plant for the production of 30-mm. cannon shells, at the rate of 500,000 per month. This plant includes much interesting equipment, and is being maintained in working condition pending the receipt of a further order. Another division has been started for the production of gate and globe type valves, and the manufacture of the patented Garrington constant-velocity universal joint is now being undertaken by yet another division. It is envisaged that these joints, which were described in MACHINERY, 89/244—27/7/56, may soon be required in numbers up to 1,000 per day, and plans have been made accordingly. The joints are made in a range of sizes to suit different applications on motor vehicles, machine tools, aircraft, agricultural machinery, and ships.

BLADE PRODUCTION METHODS

Several different approaches to the problem of producing blades for gas turbine engines are possible. Among the more interesting of the methods at present in use is abrasive-belt form grinding, on machines designed by J. L. Jameson, Ltd., towards the end of the war, whereby blade aerofoil surfaces with only moderate degrees of twist can be accurately and quickly finished from rough forgings, and a considerable number of these machines, which will be described in a later article in this series, has been installed. For the production of blades which cannot be finished on the Jameson machines, because of excessive twist or for other reasons, large numbers of Ex-Cell-O aerofoil milling, grinding and polishing machines have been provided. To supplement these and other special machines introduced by outside companies, a design and development office was established, which has been responsible for the design of several machines for operations on blades, and particularly on the important fillet radius at the point where the aerofoil portion meets the root or platform. Some of these latter machines will also be described in these articles.

When an enquiry is received for the manufacture of a new type of blade, the choice of the methods to be employed is governed by a number of considerations, including the form of blank from which it is to be machined; the design of the blade, including the shape of the aerofoil section and the root portion, and the amount of twist required; the quantity involved; the time available; the loading on the particular machines which are suitable for finishing the aerofoil, and the material specified. The shape of the blank may vary from a solid rectangular block of material, where only small quantities of blades are required for experimental purposes, to a precision forging. Normally, small quantities of experimental blades are machined in a special development department, so that in the production area of the factory the majority of blades are made from rough or precision forgings.

Material must usually be removed from all the surfaces of rough-formed blades and the normal procedure is to grip the blank in the aerofoil portion while the root is machined by a series of milling, broaching or grinding operations. The root is then employed, in conjunction with a forged pip on the end of the aerofoil portion, for holding the blade firmly while the aerofoil portion is machined by one of the methods mentioned above. Subsequently, the forged pip is removed by grinding. This procedure is adopted for most of the blades machined from stainless steel, Nimonic alloys, and titanium.

Precision-forging is generally restricted to alloys of aluminium and stainless steel, although it is sometimes employed for blades of titanium alloy. Such blades are received with the aerofoil portion forged to the required shape by methods similar to those employed by the Bristol Aeroplane Co., Ltd., and described in MACHINERY, 85/419—27/8/54, to a tolerance of 0·005 in. or less on thickness, so that they require machining only on the root portion. Light polishing of the aerofoil surfaces and of the leading and trailing edges, and removal of the forging pip at the outer end, complete the series of operations on such a blade. Forgings are supplied to the B.R.D. Co., Ltd., by the engine manufacturer, or, where the company has contracted to supply the complete component, by Garringtons, Ltd., another member of the G.K.N. Group. In addition to British makers of gas turbine engines, the company has supplied blades to continental firms, and is also engaged in the production of blades for steam turbines. This article is concerned with operations on typical precision-forged aluminium alloy blades for gas turbine compressors. An assembled compressor rotor for the Bristol Proteus propeller gas turbine, having 12 axial flow stages and a final centrifugal stage, is seen in the heading illustration.

OPERATIONS ON PRECISION-FORGED BLADES

Before a blade made by precision forging leaves the factory, it is usually heat-treated to release stresses, and pickled or anodised. When light alloy forgings are received at the B.R.D. works, they are first inspected, and then the protective anodic film

is removed. Before they enter the machining area, the blades are placed in special boxes fitted with partitions, so that they are not in contact and cannot damage each other. Each box is designed to hold about 50 blades and they are accompanied throughout the machining stages by a card which gives the part and batch numbers, details of the material, the number of blades in the batch, and a list of operations. Each blade is also stamped with its batch number, so that any operation on a faulty blade can easily be checked by reference to the card at any subsequent time. After each operation, the card must be stamped by a patrolling inspector before the box of blades can proceed to the next machine in the line.

Normally, the first operation on a precision-forged blade is to machine the leading and trailing edges, which are deliberately left oversize at the forging stage because of their extreme thinness. The accurate surfaces thus produced can then be employed for positioning the blade at later stages in the manufacturing sequence. Machining of the leading and trailing edges is performed on special machines of the type illustrated in Fig. 1, which was designed by the B.R.D. Co., and built by Waddington Tools, Ltd. There are several of these machines in the factory, and they are arranged in pairs, each pair being tended by a single operator who loads one fixture while the cutting cycle of the other machine is in progress. From Fig. 1 it will be seen that the machine is of fabricated construction, and the flat top is supported on a framework, enclosed by sheet metal panels.

There are guideways on the top plate for two spindle heads which may be adjusted towards or away from the work fixture. Each spindle is driven through V-belts, at a speed of 900 r.p.m., by a 1-h.p. motor, mounted on an adjustable platform above the head, and is fitted with an end milling cutter of 1 in. diameter, which has six helical teeth. On the side of each milling head adjacent to the fixture, there is a roller, mounted with its axis vertical, and on each side of the fixture there is a cam surface. The rollers on the heads are thrust into contact with the cam surfaces by means of centrally-pivoted vertical levers beneath the machine top plate. Air cylinder rams, connected to the lower ends of these levers maintain a constant pressure to hold the rollers against the cam surfaces.

The fixture is moved on dovetail ways by a long-stroke cylinder *A*, secured to a bracket at one side of the machine top plate. This cylinder is filled with oil on both sides of the piston and it is connected to the lower cylinder *B*, of the same size, which is also filled with oil. Adjustable restrictor valves are fitted in the connecting pipes, so that the speed of movement of each ram may be varied to give the rate of feed required for the milling operation. The ram of the lower cylinder *B*, is connected directly to the ram of a double-acting air cylinder carried in brackets in a horizontal position within the machine base. The supply of air to this cylinder is controlled by means of the valve *C*, which is of the semi-automatic type, and —in common with all the other pneumatic equipment on these machines—was supplied by Lang Pneumatic, Ltd.

Fig. 1. General View of a Special Duplex Machine Designed by the B.R.D. Co., Ltd., for Milling the Leading and Trailing Edges of Precision-forged Blades to Provide Locating Surfaces for Subsequent Operations

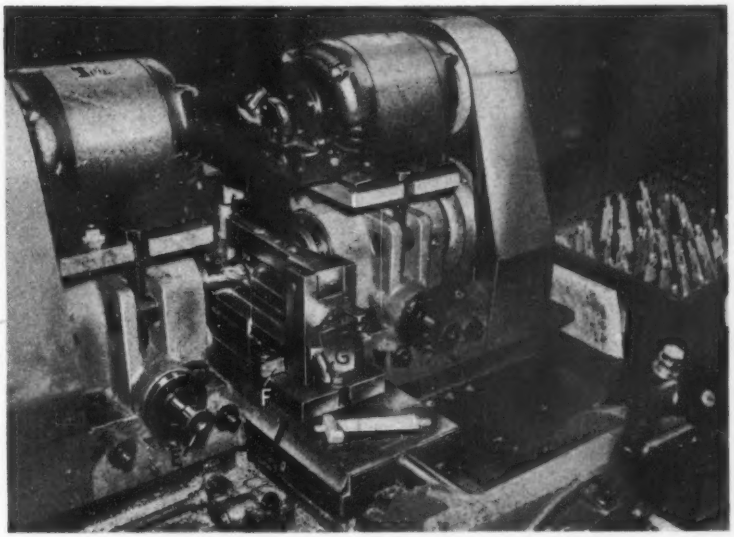


Fig. 2. Close-up View of One Half of the Machine in Fig. 1, Showing Details of the Spindle Heads and the Fixture in which the Blade is Held. Cams *F*, on the Sides of the Fixture, Control the Positions of the Spindle Heads

When the lever of the valve *C* is moved to the left, air under pressure is allowed to pass to one side of the air cylinder, with the result that the piston in the cylinder *B* is moved inwards, towards the machine. The oil displaced from the inner end of this cylinder is allowed to flow at a controlled rate, according to the setting of the restrictor valve, into the outer end of the upper cylinder *A*, to move the fixture towards the cutters. Before the valve can be operated, a push-button on the box *D* must be depressed to start the cutter-driving motors. At the end of the fixture traverse, an electrical limit switch and a Lang pilot valve, mounted on the machine top plate, are operated by a spring-loaded lever, the arrangement allowing for a slight over-run of the fixture without damage to the switch. Current to the relay through which the motors are supplied is cut off by the micro-switch, so that the motors are stopped, and, at the same time, the setting of the valve *C*, which incorporates a small air cylinder, is reversed by the pilot valve.

As a result, the direction of the air supply to the cylinder within the machine base is reversed, so that the piston of the cylinder B is moved outwards and the piston of the cylinder *A* is caused to travel in the same direction, to withdraw the fixture to the rear, ready for re-loading. For the aluminium alloy blade which is machined with the set-up shown, the fixture is fed through a distance of 4 in. at the rate of 24 in. per min. For stainless steel blades, a lower feed rate is employed. A close-up view of the fixture on the machine is given in Fig. 2, which also shows one of the cutters, and a blade in the foreground. The width of the blade depends on the position which it is to occupy in the compressor, and the distance by which the roller on each head projects towards the fixture can be varied, to change the blade width, by turning the shaft *E*. One of the cams is seen at *F*.

In the fixture, the blade is loaded with the concave side upwards and rests on a support block. The upper face of this block is machined to match the curvature of the convex side of the blade, which is clamped by means of another block attached to a hinged bar above. The lower face of this second block is machined to match the concave side of the blade, and it is held down by means of a swivelling stud and star-wheel nut, at the further end of the fixture. Pips of semi-circular section are forged on the blade at each end, and are employed for positioning the blade sideways in the fixture. Endwise, the blade is located from the platform face, adjacent to the aerofoil portion, which is pressed against matching surfaces on the support and clamping blocks by means of a pin connected to the hand lever *G*, while the star-wheel is being tightened. From each machine of the pair, an output of 72 blades per hour is normally maintained.

Most of the inspection equipment employed in the factory is of conventional type, and consists largely of optical projectors of well-known makes. For those operations for which a projector is not suitable, nest-type fixtures, such as that shown in Fig. 3, may be provided. This fixture enables the width of the blade to be checked at five posi-

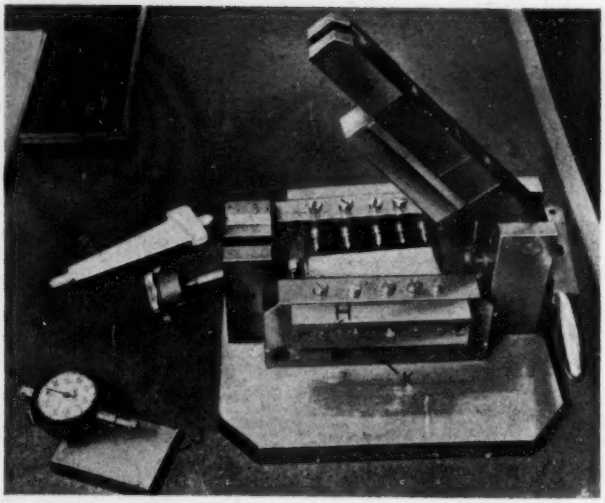


Fig. 3. In this Inspection Fixture, the Width of the Blade can be Checked at Five Different Positions with the Aid of the Dial Indicator at the Left, which is Graduated in 0.001 in. Divisions

tions, and the design is somewhat similar to that of the machining fixture. The blade is located and clamped in the same manner as before, and the five pins, one of which is indicated at *H*, are then pressed in on each side by hand, until their chisel ends are in contact with the milled surfaces. The plate at the lower left, which has accurately finished surfaces on the base and at *J*, and carries a Baty dial indicator with 0·001 in. divisions, is then placed on the projecting base of the fixture, with the surface *J* in contact with the face *K*. To check the amounts by which the pins *H* project, the plunger of the dial indicator is applied to the end of each, in turn. The blade is held to limits of −0·000 +0·002 in. on each side, so that the total tolerance on the width is 0·004 in.

MILLING OPERATIONS ON THE ROOT

As is well known, there is no standard design of root, and the number of variations is probably as great as the number of different designs of blade, of which approximately 350 are machined by the B.R.D. Co. Root shapes range from a simple rectangular section to the complicated fir-tree form specified for turbine blades intended to operate at high temperatures. Where the quantity of blades required is not sufficient to justify expenditure on broaches, which generally are preferred, the root end may be shaped by milling or grinding, or by a combination of these methods. For the blade shown in Fig. 3, a modified fir-tree root form is specified, and, at the first stage in the machining sequence, the end surface is milled flat, and at a compound angle to the aerofoil axis. The set-up for milling this surface is shown in Fig. 4, and the Cincinnati No. 118 horizontal machine is arranged to operate on the normal automatic cycle. A Galtona (Richard Lloyd, Ltd.) cutter with eight inserted blades of high-speed steel

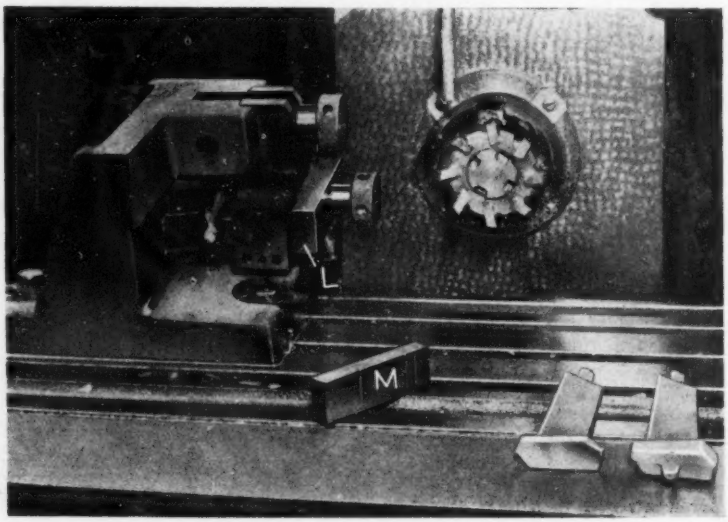


Fig. 4. At this Set-up, the End Surface of the Root End of the Blade is Milled Flat, at the Correct Angle to the Aerofoil Portion. The Stepped Block *M* is Employed for Inspection in Conjunction with the Fixture

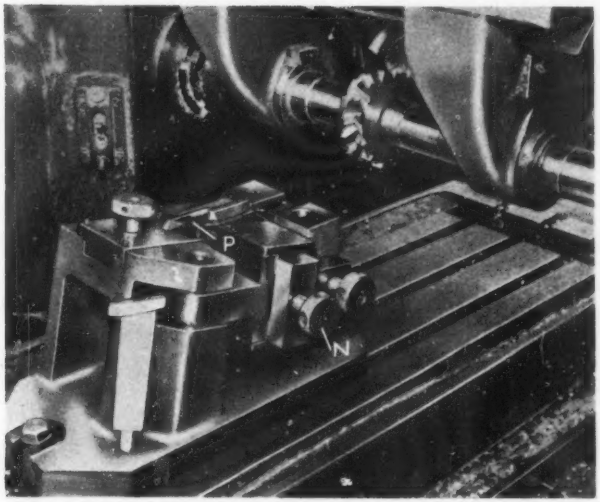


Fig. 5. A Werner Horizontal Milling Machine is Employed for Milling the Sides of the Root End, to an Included Angle of 30 deg. for the Example Shown, with a Pair of Matched Angular Milling Cutters

is driven at a speed of 1,200 r.p.m., and a feed rate of 2½ in. per min. is employed.

In the fixture, the blade is located from the leading and trailing edges, and the support and clamping blocks make contact with the aerofoil portion on two narrow bands near the ends. The greater clamping pressure is applied to the root portion by means of the lever *L*, which is tightened by applying a tommy bar to holes in the lower knurled nut, after the hinged portion of the fixture, carrying the lever, has been swung upwards and secured in position. An interesting feature of this set-up is the provision of the gauging block *M*, which has a stepped face on one side. This face is placed in contact with a datum surface on the far side of the fixture, and moved towards the end face of the blade root which has just been milled, to determine whether it is within the specified limits. The first step should pass over the face, and the other, which is 0·004 in. shallower, should not.

Another milling set-up, shown in Fig. 5, is employed for machining the sides of the root to an inclusive angle of 30 deg., to reduce the amount of material to be removed subsequently by grinding. This operation is performed on a Werner (Rockwell Machine Tool Co., Ltd.) type 8102 machine, with a pair of matched, angular side and face cutters, of solid high speed steel. These cutters, of 4 in. diameter, are driven at 450 r.p.m., and the feed rate is approximately 9 in. per min. The blade is again located by the leading and trailing edges and by the platform face, and is clamped on the aerofoil portion by blocks shaped to match the curved surfaces. Pressure is applied to the clamping blocks at each end of the blade portion by means of the knurled nut *N*, after the swivel-mounted clamping member has been moved into place and secured with the other knurled nut. Support for the root portion, against the milling cut, is afforded by a blade *P*. This blade is integral with a plate which is guided in ways in the top surface of the fixture, and is spring-loaded towards the work. After the fixture has been loaded, the plate is clamped, in the position which it has taken up, by means of the third knurled nut, above the fixture.

THOMPSON ROOT GRINDING MACHINE

On those blades which are not required in sufficient quantities to justify the purchase of broaching equipment, root serrations are normally produced by grinding, irrespective of the blade material. Root grinding machines of three different makes are installed, and the type of machine to be employed for a particular blade design is determined mainly by considerations of shop loading. Allocation of work is facilitated by the fact that the fixtures employed on all three machines have the same outside dimensions, and are interchangeable from one to the other. One of the machines, made by the Thompson Grinder Co. (Rockwell Machine Tool Co., Ltd.) is shown in Fig. 6. A feature of all the root grinding machines is the provision for removal of the fine mist of coolant produced by the grinding wheels, and to this end the machines are totally enclosed by sheet metal covers which confine the mist. The mixture of air and fine oil droplets is extracted through trunking by a fan, and drawn through Precipitron (Sturtevant Engineering Co., Ltd.) electro-static filters, whereby the oil is removed and can be returned to the tanks of the machines.

All three machines are also fitted with automatic band-type filters, with muslin bands up to 30 in. wide, for removing fine abrasive and metal particles, and where the coolant tends to become

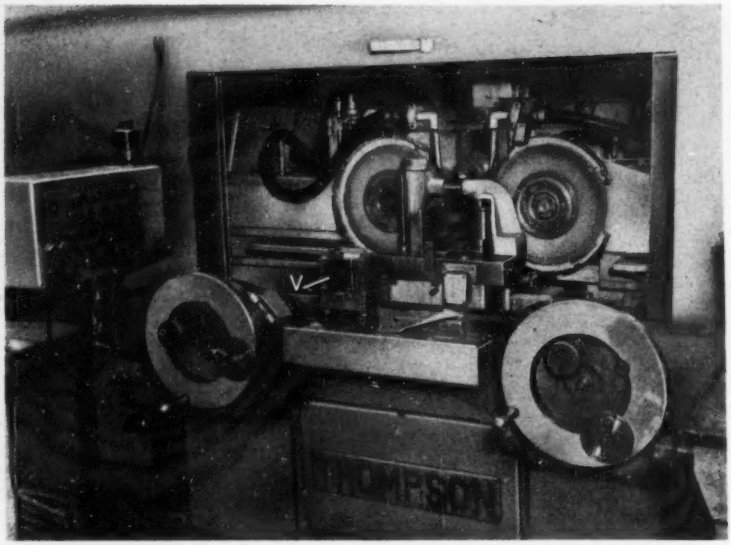


Fig. 6. General View of the Thompson Root Grinding Machine Employed for Operations on Aluminium and Stainless Steel Blades. The Twin Wheels are Driven by Integral Motor Units

heated, a Frostrode refrigerating cabinet is incorporated in the coolant system. This cabinet contains a heat exchanger, through which the coolant is pumped, and can be adjusted so that the fluid leaves at temperatures between +10 and −20 deg. above or below the entry temperature. The Thompson machine, of the Truforming type, has two grinding wheels on horizontal spindles, each of which carries the rotor of the 5-h.p. integral driving motor. The spindles are mounted on slides which incorporate hydraulic cylinders, and the ram of each cylinder is connected to a nut carried on a screw, disposed parallel to the direction of motion of the slide.

On the outside of each nut there is a flat vertical surface, and on the outer end of each slide there is an adjustable stop with graduations. During the normal grinding cycle of the machine, the heads are fed in by the hydraulic cylinders towards the component, which is held in the fixture between the grinding wheels and reciprocated vertically by a hydraulic ram. These cylinders move the slides inwards until the adjustable stops come into contact with the flat surfaces of the nuts. Additional in-feed of the wheels can then be obtained by turning the screws, either by hand or by means of small hydraulic cylinders, the housings for which can be seen beneath the hand control wheels in Fig. 6. The operation of these cylinders is automatically controlled by the electrical circuit of the machine, and movement of the pistons is transmitted, through rack and pinion and ratchet mechanisms, to the shafts on which the hand control wheels are mounted.

The arrangement of the ratchet mechanisms enables variable amounts of in-feed to be applied to each head, in increments of 0·00002 in., up to a maximum of 0·010 in. for each reciprocation of the work. Some further details of the machine may be observed in the close-up view in Fig. 7, where one of the box-type fixtures is seen in the grinding position. As has been mentioned, the slide which carries the fixture is moved vertically for the grinding operation, by a hydraulic cylinder, and it is carried on two large-diameter parallel cylindrical bars, on which it can also be moved horizontally, to advance the work from the loading to the grinding position, by another cylinder. The fixture is supported on a flat surface and is pressed sideways by the operator, during the loading operation, against a vertical face which provides accurate lateral location. For endwise location, there is an adjustable stop at the rear of the fixture, against which the latter is pulled by the operator, while the clamps are tightened.

Clamping of the fixture is also effected hydraulically, by means of a vertical cylinder within the housing *R*, and a horizontal cylinder beneath the upper face of the slide. The cylinders are connected, through racks and pinions, to two eccentric shafts S and *T*. When these shafts are rotated by the action of the cylinders, their eccentric portions are brought into contact with the upper and side surfaces of the fixture to secure it in position. The machine cycle is fully automatic after the loading operation has been completed and the cycle-start button pressed, and two sliding doors, of transparent plastics, are first closed by two small air cylinders. Next, the fixture is advanced into position between the wheels, and as the vertical slide starts to move up and down, the wheel-heads are rapidly advanced by the hydraulic

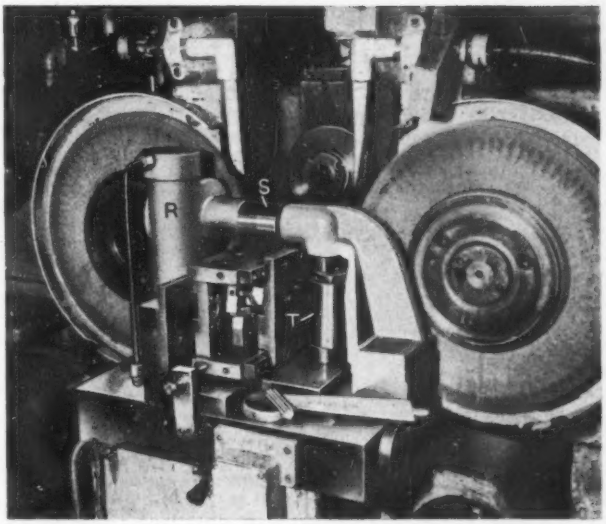


Fig. 7. Close-up View of the Thompson Machine, Showing the Method of Clamping the Box-fixture in which the Blade is Held. The Finished Serrations are Checked on Optical Comparators

cylinders, and the feed is then applied.

For grinding aluminium alloy blades, a wheel speed of 1,500 r.p.m. is employed, and the in-feed is set at the maximum of 0·010 in. per pass. At the end of the cycle, the wheel-heads are automatically retracted, the screws are returned to their original positions, ready for the next cycle, and the vertical slide is returned to the unloading position. The box fixture is then removed for reloading, or, if the quantity justifies the cost, is replaced by a second fixture, which has been loaded during the preceding cycle. Aluminium alloys are ground with Carborundum wheels of CC-150-N8-VR specifications and of 18 in. diameter, when new. Similar wheels have been used for grinding titanium alloys, but the speed was reduced to half that quoted above. For stainless steel and Nimonic alloys, a typical specification is Norton 38A-1804-L9-VBE, and the 18-in. diameter wheels are run at a speed of 1,500 r.p.m.

The grinding wheels are crush-dressed when new, also at intervals during production when the form produced on the work approaches the specified limits, as indicated by an optical projector installed nearby. Crush-forming is carried out by means of a unit mounted on the parallel cylindrical bars which support the vertical slide. This unit can be advanced to bring the forming roll between the wheels, as shown in Fig. 8. The slide on which the crushing roll is mounted can be moved vertically by a hydraulic cylinder, so that the horizontal roll shaft is lowered to a position level with the grinding wheel axes. The grinding wheels are next brought into contact with the roll by turning the large handwheels at each side, and the left hand wheel is then driven slowly for the crush forming operation, by a small geared motor. The drive is transmitted to the crushing roll and thence to the other grinding wheel.

With both wheels in contact with the crushing roll, the automatic in-feed mechanism of the

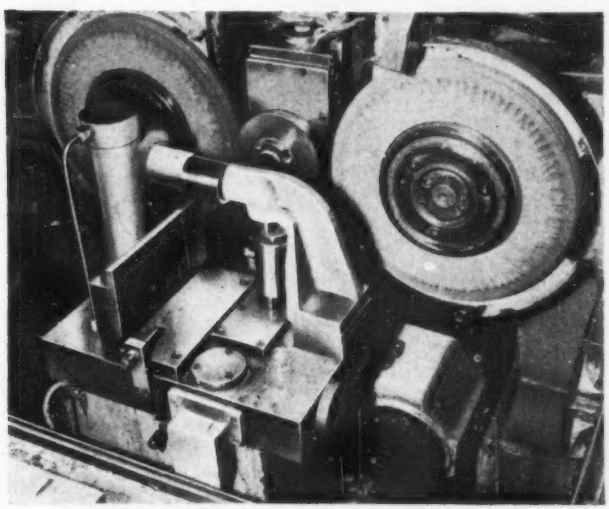


Fig. 8. The Wheels on the Thompson Machine are Simultaneously Crush-dressed with the Aid of the Crushing Roll, here seen Advanced and Lowered into Position. The Crushing Cycle is Automatic

machine can be employed to apply feed increments, as required. For crush-forming, the wheels are fed in at the rate of 0·0004 to 0·001 in. for every 10 revolutions. Although the operation is not often performed at the B.R.D. works, it may be noted that provision is made for grinding crushing rolls on this machine. The right-hand wheel is first diamond dressed to the required form with an attachment provided, which is mounted on a platform at that side of the machine. A small motor on the crushing roll unit is then employed to drive the roll slowly, while the right-hand wheel is fed in to grind the periphery. Roughing and finishing operations are required, and after the roll has been ground it is employed to dress both wheels, as described above.

Various designs of box fixtures are employed, according to the shape of the blade and the stage to which it has been brought by the preliminary operations, and a typical fixture for the Thompson machine is seen at *V* in Fig. 6, and in position on the vertical slide in Fig. 7, where a finish-ground blade is also shown. One of the wide faces of the box is formed by a removable lid, and on the opposite inner face there are location surfaces for the leading and trailing edges of the blade and a support block which matches the convex side of the aerofoil portion. The lid has stepped holes at the corners to match four cheese-head screws on the fixture, and these holes are so formed that the lid can be passed over the screws and moved sideways into place.

On the inside surface of the lid there is another block, formed to the shape of the concave surface of the blade aerofoil and held in place by two other cheese-headed screws, the heads of which are accommodated in counter-bored holes in the lid. A socket grub-screw between these two attachment screws is tightened, to clamp the blade in place, with the aid of a hexagon socket spanner, a light pressure being applied initially. Before the clamping screw is finally tightened, the root end of the blade is lightly tapped inwards, so that the platform surface is in contact with the end faces of the support and clamping blocks.

EX-CELL-O ROOT GRINDING MACHINE

First briefly described in MACHINERY, 79/776—1/11/51, the Ex-Cell-O root grinding machine has two wheels with their axes vertical. A close-up view of one of the machines of this type installed in the B.R.D. works is shown in Fig. 9, and the arrangement of the portion which is out of sight on the right is similar to that on the left, except that it is of the opposite hand. A box fixture, of similar design to that just described, is seen, open, in the right foreground, with a blade in position ready for grinding. The lid has here been removed and inverted to show the clamping pad *W*, and it may be noted that the pads are made by casting zinc-base alloy in moulds having surfaces of the required aerofoil shapes. After it has been loaded, the fixture is placed in a vertical position, with the root end of the blade projecting upwards from its top face, on a slide which is arranged for horizontal movement between the two grinding wheels.

Surfaces on the slide locate the fixture accurately, and it is clamped by two hinged levers, one of which

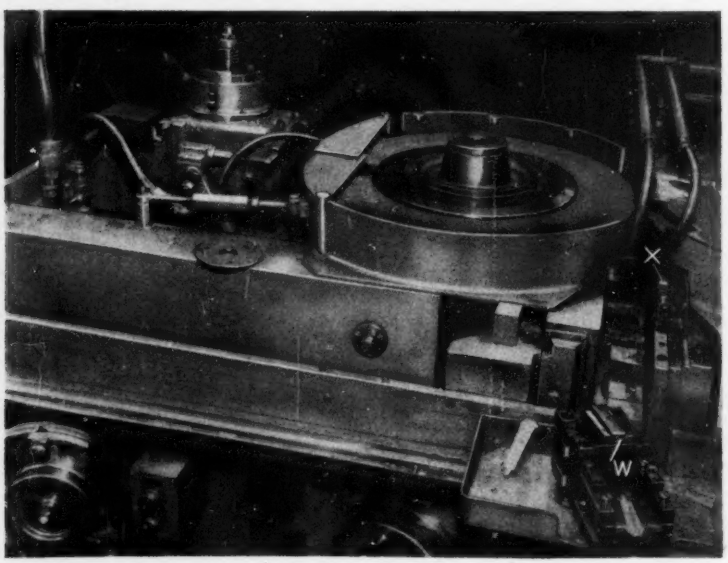


Fig. 9. Close-up View of the Ex-Cell-O Machine for Root Grinding Operations, Showing One of the Grinding Wheels, which are Carried on Vertical Spindles, and the Diamond Dressing Unit at the Left

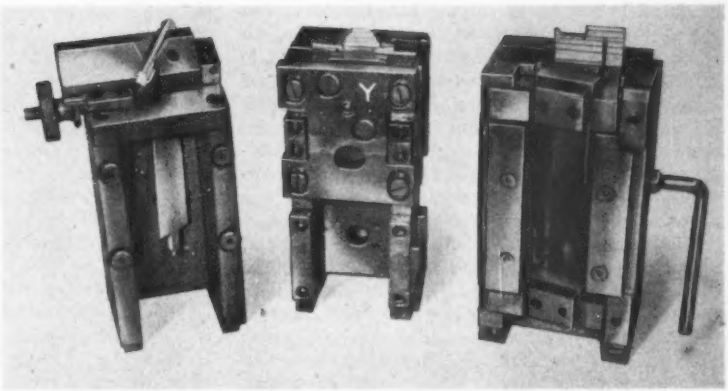


Fig. 10. Some Typical Fixtures Employed on the Root Grinding Machines for Different Types of Blade. (Left) A Fixture for Use when Grinding the Oblique Faces on the Ends of the Root. (Centre) A Fixture Similar to that Shown in Fig. 9. (Right) A Fixture for Semi-precision Forged Blades

is indicated at *X*. These hinged levers are operated through a wedge system, by a hydraulic cylinder. The fixture is passed through a small loading aperture provided in the sheet metal covers which normally enclose the machine. On depressing the cycle-start button, the horizontal slide moves forward to the grinding position and the wheel-heads move in. The slide is then reciprocated between the wheels, the speed being slightly higher when it is moving in the opposite directon to the wheel surfaces, to ensure that equal amounts of material are removed at each pass. The number of passes during the automatic cycle can be pre-selected, and the wheels are fed in by a predetermined amount at the end of each pass. For aluminium alloy blades, this in-feed is of the order of 0·018 to 0·020 in. per pass, for each wheel.

When a root that approaches the required finished dimensions has been forged on the blade, it is possible to dispense with the milling operation described, and to grind the sides of the root from the solid. With this procedure, however, it is necessary to dress the wheels more frequently, and grinding time is necessarily increased. When grinding serrations in milled surfaces, it is possible to finish as many as 2,000 aluminium alloy blades before the wheels require to be re-dressed. The number is, of course, much smaller when harder materials are being ground. The wheels employed are of 24 in. diameter when new, and are of the same specifications as those for the Thomson machine. They are trued to the required form by means of diamond dressing units, one of which is seen at the left in Fig. 9. This unit incorporates a slide-mounted diamond tool, which is moved vertically across the face of the wheel by the multi-start screw seen projecting from the top. As the diamond is moved down, it is also moved horizontally, to produce the required form, by a cam mounted on the screw spindle. Provision is made for automatic advance of the grinding head to compensate for the reduction in wheel diameter, and the complete cycle is automatically controlled. A selector switch can be set so that dressing is carried out after a given number of passes, after a given number of cycles, or under the control of the operator.

BOX FIXTURES

Since the third type of root grinding machine—the Matrix, made by Coventry Gauge & Tool Co., Ltd.—is employed mainly on blades of stainless steel or Nimonic alloys, it will be discussed in a later article. Before leaving the subject of root grinding, however, it may be of interest to consider some different designs of fixture, examples of which are shown in Fig. 10. Fixtures of this general type were originally introduced when most of the operations on blade roots were performed by milling. At that time, each milling machine was equipped with a hydraulically-operated clamping unit with locating surfaces so arranged that the box fixture could be held at the required angle for the particular operation to be carried out. After a blade had been loaded into a box fixture, in which it was located and clamped on the aerofoil portion, the fixture could be passed from one machine to the next down the line, without disturbing the blade, until all the operations on the root had been completed.

At the end of the line, the fixture was unloaded, the blade was passed on to the aerofoil machining area, and the box fixture was returned for re-loading. This procedure has now been largely superseded by grinding and broaching, but when replacements for blades produced by milling are ordered, they are machined with the same fixtures,

which are retained in store. The fixture at the left in Fig. 10 is designed to hold a blade, on which the root serrations have been finished, while the end faces of the root are ground at an oblique angle, on a machine having wheels dressed to the required angle. The blade is located from the leading edge, and is clamped on the previously-ground root serrations, which also provide for end-wise location, by means of a slide operated by means of the knurled nut at the left.

The fixture at the centre in Fig. 10 is of similar design to that described in connection with the Ex-Cell-O machine in Fig. 9, and is shown with the lid *Y* in place, ready for clamping. In the fixture at the right, the stainless steel blade forging, which is of the semi-precision type, is positioned by flat surfaces milled on the forged pip at the lower end, which fit into a V-location, and by the four sides of the root portion at the upper end. Swinging clamps, hinged at the left-hand side, are moved into position and engaged by pivoted stirrups at the right. Clamping pressure is then applied by tightening socket grub screws in the stirrups. The handle at the right is employed solely for convenience in loading the fixture into the machine.

MORRIS EDGE-POLISHING MACHINE

When all the grinding operations on the root portion of a precision-forged blade have been completed, it is passed to the machine shown in Fig. 11, on which the leading and trailing edges are polished and blended with the aerofoil surfaces. Developed as the result of co-operation between the Bristol Aeroplane Co., Ltd., and B. O. Morris, Ltd., the makers, this machine is equipped with an endless belt, made from felt, which is dressed with an abrasive material. As described in MACHINERY, 84/974—7/5/54, the machine is powered by a motor of 2½ h.p., which drives the 6-in. diameter main pulley *A*, at a speed of approximately 1,500 r.p.m., so that the belt speed is about 2,300 surface ft. per min. Beneath the main driving pulley there is a holder for a stick of polishing compound, which is automatically applied to the belt during the polishing operation. For aluminium blades, a Tripoli emery compound of 120 G, and for steel alloys, of 60 G specification, is applied.

The belt passes over a pair of idler pulleys at the top and a single idler just above the main driving pulley. In addition, there are two guide pulleys *B*, just above the single idler, and the shafts for these pulleys are carried by ball-joint mountings on the slotted, inclined supports for the upper idler pulleys. With this arrangement, the pulleys *B* can be so adjusted, both for height and angle, that they will allow the belt to flex so that the full width is in contact with the blade edges as the blade is turned. The blade is located from the serrations, and is clamped on the root end, in a holder *C*, on the end of a shaft, the housing for which is clamped between two slotted bars, hinged at their lower ends to the machine base. The shaft carrying the holder *C* is rotated slowly, through bevel gears, which provide for reversing the direction, by a flexible shaft driven from the main motor.

A rod *D* connects the two slotted bars to a crank arm, driven through V-belts from the main motor, and, as this rod moves, the bars are pivoted about their hinge point. The rod can be disconnected from the slotted bars, by means of a latch operated by the ball-handled lever *E*, to allow the bars to be retracted to

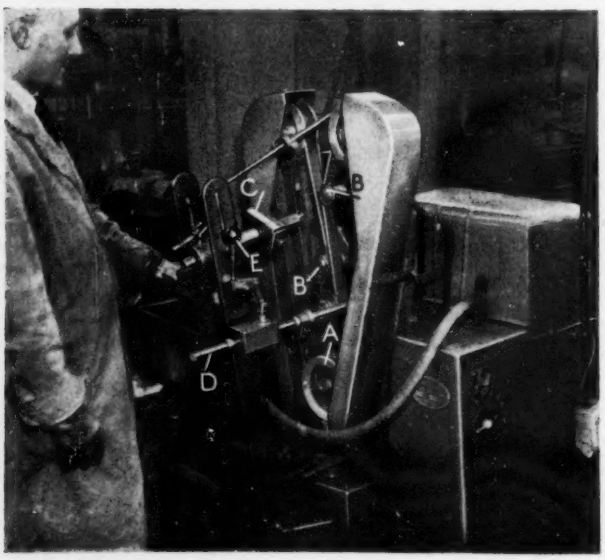


Fig. 11. This Morris-Bristol Machine is Employed for Polishing the Leading and Trailing Edges and Blending them with the Aerofoil Surfaces by Means of an Abrasive-charged Felt Belt, Driven by the Pulley *A* at 2,300 ft. per min.

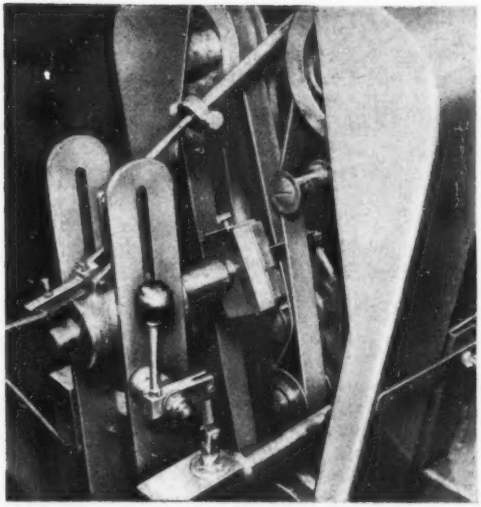


Fig. 12. Close-up View of the Morris-Bristol Machine with the Blade, in its Holder, in Position Between the Belt Surfaces. The Blade is Rotated and Moved Horizontally for the Polishing Operation

the position shown, for loading. A close-up view showing the machine loaded, and the arms in the advanced position, with the blade between the belt surfaces, ready for the polishing operation, is given in Fig. 12. With the blade between the belt faces, the machine is started, and as the slotted arms are oscillated they carry the blade backwards and forwards. At the same time, the bevel gear clutch is operated so that at the end of each oscillation, which occupies a period of about 3 sec., the direction of rotation of the blade is reversed. An equal action on the leading and trailing edges is thus obtained.

At the end of a pre-determined number of strokes of the slotted arms, a timing mechanism is operated which switches off the current supply to the motor, so that the machine stops. For most of the aluminium alloy blades at present in production, a 1½-in. wide belt is employed. In addition to producing radii on the leading and trailing edges, the operation serves to remove approximately 0·005 in. of material left on the blade width at the initial milling stage. On aluminium blades, the operation is completed in about 30 sec., and on alloy steel blades, in about 1 min. From the edge-polishing machine, the blades pass to an area where the aerofoil and the adjacent platform surfaces are lightly polished by hand, on mops, and then to a battery of Taylor, Taylor & Hobson pantograph engraving machines. Here, the part and batch numbers, the company's initials, and the identifying numbers of the material specification are engraved on the root end of each blade.

SEMI-AUTOMATIC CUTTING-OFF MACHINE

These operations leave the blade with the aerofoil portion still of the original forged length and with the locating pip in position, and at the next stage, the blade is cut to the required length. This operation is carried out on the modified surface grinding machine (Beacon Machine Tools, Ltd.) shown in Fig. 13. The table of this machine carries a sheet metal tray which collects the soluble oil coolant employed, and a flexible

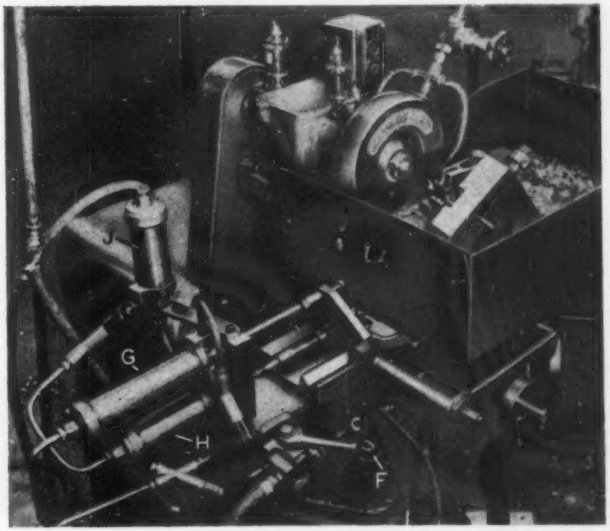


Fig. 13. For Cutting Off the End of the Aerofoil Portion to the Required Length, this Beacon Machine Tools Surface Grinder, Fitted with an Air-hydraulic Feed System, is Employed

tube connected to one corner provides for the return of the fluid to the tank, by gravity. Inside this tray is the fixture in which the blade is located from the root end, and clamped on the aerofoil portion by means of a slotted lever. The lever is provided with a pad to match the contour of the blade, which is pressed down to a support pad, and the fixture is so disposed that the end of the blade is trimmed off at the required angle.

A Universal wheel of A-46Q-B specification is employed for both aluminium and alloy steel blades. The wheel is of 6 to 8 in. diameter, and soluble oil is delivered by a small pump unit on the floor at the side of the machine, and directed through jets on to each side of the wheel. After the operator has loaded the fixture, and started the cycle by moving the air valve lever *F*, the operation is automatic. This valve controls the supply of air to the cylinder *G*, the ram of which is connected to a bracket attached to the end surface of the machine table, and, when the valve is operated, the table is moved rapidly towards the left. Just before the work makes contact with the wheel periphery, the bracket comes in contact with the end of the ram of a hydraulic check cylinder *H*.

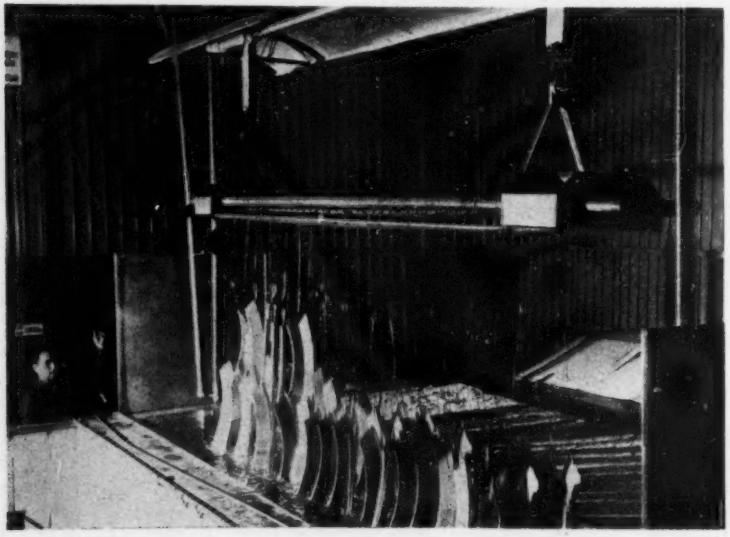
This ram controls the cutting feed of the table, oil being transferred from one side of the piston to the other. Excess oil is forced into the reservoir *J*, against the pressure of a spring-loaded piston. At the end of the cutting-off stroke, the table remains at the left, and must be returned by operation of the lever *F*. The machines have the advantage of low first cost, and the number installed is such that one can be set aside for each blade which is in production, so that re-setting is not required for different blade designs. A battery of some 30 machines is tended by 2 or 3 operators.

Final inspection is carried out with the aid of Sigma units, such as that described in MACHINERY, 91/604—13/9/57, on which the aerofoil section can be checked at five different positions, also the length, width, radial and axial lean, and angular displacement of the blade portion. For inspection operations on the root end, optical projectors are mainly employed, as stated earlier. Prior to final inspection, some blades are subjected to a stress-relieving heat-treatment, and with some stainless steel blades such treatment may result in a slight growth in the overall length. This difficulty is overcome by leaving a small piece of metal on the blades at the cutting-off operation, and grinding them to length after heat-treatment.

"Free Fall" Quenching of Aluminium Parts

During the course of a paper read recently before the American Society of Metals, Mr. Adolph Vlcek, Jr., of The Martin Co., Baltimore Division, referred to the advantages that are being gained by the "free fall" quenching of aluminium alloy parts which must be heat-treated after they have been formed. Previously, such parts were loaded into baskets for salt-bath heating and subsequent quenching. With the "free fall" method, they are suspended by hooks from a rack, and drop into the quenching bath when a quick-release mechanism is operated. In the figure, a batch of parts is seen immediately after release.

It is stated that, with this system, faster and more uniform quenching is obtained and distortion is reduced.



For "Free Fall" Quenching, Aluminium Parts are Individually Suspended, and Simultaneously Released

Special-purpose Measuring Equipment for Gas Turbine Components

At the works of D. Napier & Son, Ltd., Acton, London, W.3, a special department has recently been set up to investigate some of the numerous measuring problems that arise in connection with the firm's programme of gas turbine development and production. The company's system of turbine blade metrology, based on the use of Astrafoil and Astrascribe sheet for the preparation of master layouts and graticules for optical projection equipment, was reviewed in MACHINERY, 90/659—22/3/57. In a later article (90/759—5/4/57) some examples of special-purpose projectors, designed for use with this system, were described. Here, two further items of equipment are considered, which have been developed by the new department.

Magnesium-alloy stator rings, of the type shown in Fig. 1, have attachment slots which determine the angle of incidence of the assembled blades. Since even slight errors in the incidence angle can seriously impair engine performance, the angle of the slots must be maintained within ±15 min.

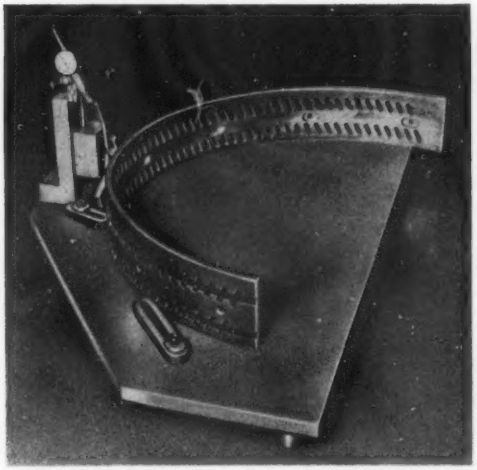


Fig. 1 Special-purpose Dial Gauge Angle Comparator, for Checking Blade Attachment Slots in Magnesium-alloy Stator Rings. The Instrument Reads Directly to 1 min.

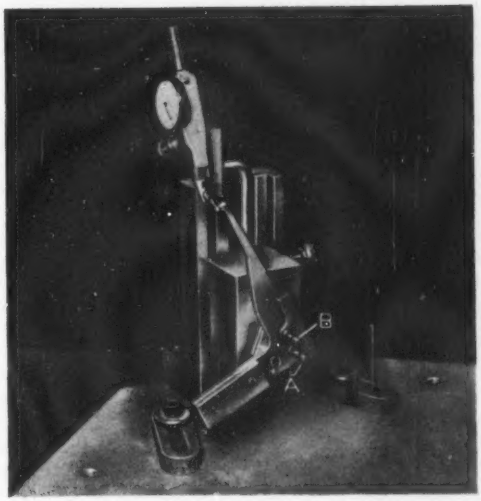


Fig. 2. A View of the Gauging Head, Showing Details of the Design, and the Contact Pins *A* and *B*

These rings are produced with one, two, three and four rows of slots, and each slot is approximately ¾ in. long and $\frac{7}{16}$ in. wide. The slots are first machined undersize on a key-seating machine, and are then finished by broaching. With the small-diameter cutters necessarily employed for the first stage, there is inevitably a certain amount of sideways spring, in opposite directions at each end of the cut. A slight "bayonet-slot" effect is thus produced, which may be sufficient to twist the broach, since the latter, also, is necessarily of a light cross-section. Compensation must, therefore, be made at the broaching set-up, and close control maintained by the use of suitable checking equipment.

For this purpose, the dial-gauge angle comparator seen in use in Fig. 1, and more clearly in Fig. 2, has been designed. The instrument has a counterweighted arm, which is pivoted, by means of a Hoffmann type S.1 preloaded ball bearing, on a pin carried on a small vertical slide. This slide is adjustable by means of a knurled knob, and the pin is extended to form a stationary

gauging contact *A*. Another pin *B*, attached to the arm, serves as a second contact. Also mounted on the vertical slide is a dial gauge, and the upper end of the arm is held by the counterweight against the contact tip of this gauge.

The dial gauge is graduated in divisions of 0·001 in., and the length of the arm is such that one 0·001-in. scale division corresponds exactly to an angular displacement of 1 min. This gauging head is mounted on a flat base-plate, as seen in Fig. 1, and the dial gauge is initially set to zero with the aid of angle gauge blocks, which are held against the contact pins *A* and *B*. Slotted adjustable stops are secured to the upper face of the base-plate, and serve to locate the work squarely in relation to the contact pins, over which the slot to be checked is passed. Unequal pressure is then applied on opposite ends of the work, so that it slides circumferentially against the stops, and the wall of the slot is thus held firmly against the contact pins. Any error in the angle is then indicated directly by the dial gauge.

Because of the leverage of the arm, considerable pressure would normally be required against the pin *B*, in order to operate the dial gauge. A fairly heavy counterweight is employed, however, which counteracts most of the spring pressure, so that quite light manual pressure on the work suffices. To facilitate checking slots inclined in either direction, the arm can readily be reversed on the pivot pin, and the dial gauge mounting is also adjustable for this purpose. The adjustment afforded by the vertical slide facilitates the checking of multiple-row rings.

CHECKING INTERNAL GEARS

Annulus gears of the type shown in Fig. 3 are employed in epicyclic reduction units for certain of the firm's engines, and have hardened and ground teeth. A formed wheel is employed for grinding the teeth, and re-dressing is necessary, periodically, during the grinding of each gear. In these circumstances, due consideration must be given to the possibility of slight variations between the individual teeth, and deviations of the pitch circle from roundness. In Fig. 3, the annulus gear is seen set-up on a special fixture developed for the investigation of variations of this type.

The gear to be checked is located by the tops of the teeth, on an accurately-fitting spigoted base-plate. In the centre of the base-plate there is a pin, on which the square platform *A* is free to turn. This platform is fitted with a pair of vertical leaf springs, which provide a floating support for the top plate *B*, and on the top of the pin, where it projects above the bearing sleeve, there is a fixed collar. This collar is ground accurately concentric with the journal portion of the pin. On the upper surface of the top plate, near one end, there is a dial gauge, and on the under-side, near the opposite end, a mating master gear is mounted on a preloaded ball bearing. The leaf springs are set so that the master gear is held lightly in mesh with the annulus gear, and, in this position, the contact stem of the dial gauge is held against the collar.

Checking is performed by rotating the top plate so that the master gear rolls on the annulus gear, and any irregularities in the teeth are indicated on the dial gauge, which has divisions of 0·001 in. If, in the course of checking in this manner, any sudden "kick" of the dial gauge pointer is observed, a closer investigation is carried out. For this purpose, a smoked glass plate is secured to the flat upper face of the collar with small pellets of Plasticine, and a stylus *C* is lowered into contact with the surface.

This stylus is mounted on an arm which is secured to the top plate by a leaf spring "hinge," and the arm is raised and lowered by means of a screw *D*. When the top plate is rotated, the stylus traces a record of ¼ in. nominal diameter, on which any variations are reproduced, actual size, as deviations from true circularity. The smoked glass record is then set up in an optical projector, and examined at a magnification of 25×, and in this way the nature of the variations can be studied and analysed. The particular tooth at fault is identified by means of a reference line

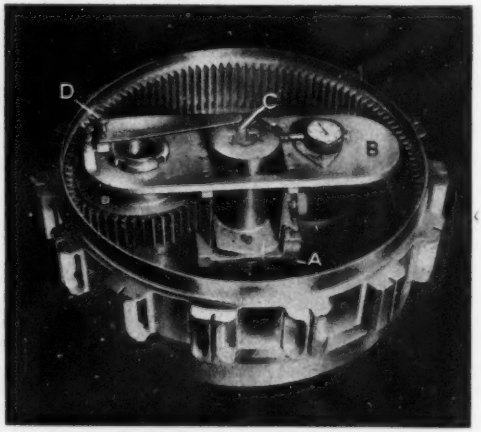


Fig. 3. This Equipment, Developed for Checking Annulus Gears with Hardened and Ground Teeth, is Provided with a Dial Gauge, and Can Also be Used for Preparing Records on Smoked Glass

scribed on the plate at the starting point of the record. This line is scribed by deflecting the top plate slightly, so that the master gear is moved away from the annulus gear, and allowing it to return. If a permanent record is required, the plate is flooded with a solution of celluloid in amyl acetate, and allowed to dry. Other examples of the firm's methods of utilizing smoked glass records were given in an earlier article in MACHINERY, 85/699—1/10/54.

Model Aircraft Factory

A management display room at the works of Chance Vought Aircraft Inc., Dallas, Texas, U.S.A., contains an elaborate model showing all the manufacturing areas and comprising some 15,000 items. In Fig. 1 is shown a general view of the sub-assembly area concerned with the F8U-1 Crusader, the fuselage assembly line being seen at the upper left. Another view of the assembly line for this aircraft is given in Fig. 2.

Apart from the value of the model for planning changes of layout, it is of great assistance to the sales department as a means of rapidly acquainting customers with the facilities available, and is used by training officials for instructing new engineers in the production arrangements. Built to a scale of ⅛ in. to 1 ft., the layout of the main assembly area covers a table 8 ft. wide by 13 ft. long. Walls, machines, racks, bins, desks and chairs are shown, and the materials used by the model makers include plastics, wood, metal and paper. To ensure good visibility the walls, roof, and girders are made from Plexiglas.

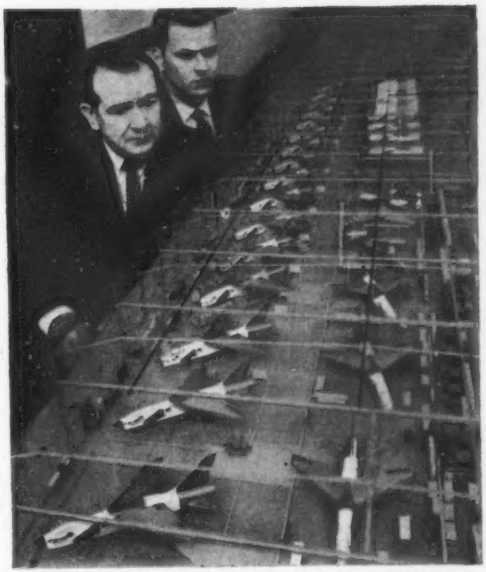
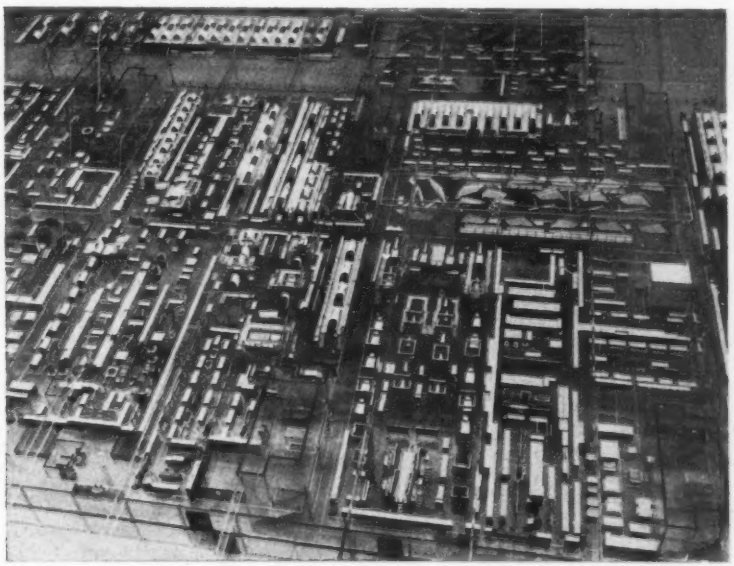


Fig. 2. A View of the Model Assembly Line for the F8U-1 Crusader



Additional smaller layouts show how the Regulus I and Regulus II assembly lines are arranged in a newly occupied section of the plant Shelves are also provided in the display room for some 40 miniature jigs and work stands which are used by tooling engineers when planning the full size fixtures for aircraft and missiles.

Fig. 1. Model of the Sub-assembly Area of the Chance Vought Aircraft Factory, which Incorporates some 15,000 Units

The Production of Stub-axle Assemblies for Volvo Cars

Methods Employed by A-B Bolinder-Munktell, Sweden

In an earlier article in MACHINERY, 92/700—28/3/58, were described some of the methods and equipment employed by A-B. Bolinder-Munktell, Eskilstuna, Sweden, for producing stub-axles for the Volvo type PV-444/45 car. As already indicated, A-B. Bolinder-Munktell are associated with A-B. Volvo, Gothenburg, and produce, for the latter company, complete stub-axle assemblies for cars, buses and large vehicles. In the section devoted to PV-444/45 components, 29 men produce 400 complete assemblies per 8-hr. working day. Here, some further machining set-ups for stub-axles, and the production of the support fittings are considered.

After the bearing-shells have been pressed into the stub-axles, and fine bored, the fork-gap, between the king-pin bosses, is finish machined to a width of 65 $+0.085+0.340$ mm. at the set-up shown in Fig. 1. The operation is performed on a Sundstrand No. 11 Rigidmil, equipped with a pneumatically-operated 2-station fixture. This fixture is arranged so that one station can be loaded while a component in the other is being machined. To ensure that the faces of the king-pin bosses are machined accurately square with the bores, the latter are employed for location.

At each station, one of these bores is engaged by a fixed peg, and the other by an opposed, movable peg, which is actuated by an air-cylinder. In order to support the work with the axis of the shaft horizontal, the parallel portion, adjacent to the threaded outer end, rests on a pad, against which it is held by the air-operated finger A. To facilitate loading, stops are provided, which engage the king-pin bosses, and serve to locate the work approximately, before the movable bore-locating peg is advanced, and the clamp-finger A is applied.

Two cutters, each of 7·87 in. diameter, and with 16 inclined, inserted, high-speed steel teeth, are run at 56 r.p.m., and machine the inner faces of the bosses at a feed of 1·58 in. per min. When the cutters have been fed to depth, the machine stops automatically. The automatic cycle is then restarted, and the table is rapidly traversed in the opposite direction, and slowed to the cutting feed. At this set-up, the floor-to-floor time per component is 1·17 min. During the automatic cycle, the operator de-burrs each milled component, and assembles the grease-nipples with the aid of a power runner.

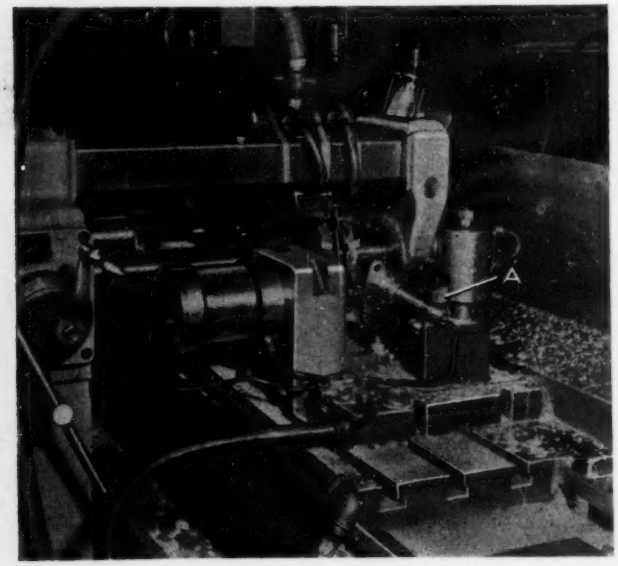


Fig. 1. At this Set-up on a Sundstrand Machine, the Fork-gap in Each Stub-axle is Milled in 1.17 min.

GRINDING

At the next stage, the shaft is ground to the dimensions and tolerances indicated in the view at *X* in Fig. 3, on a Schaudt machine, arranged for automatic sizing, and equipped with two Norton grade 32A 46K8 VG wheels,

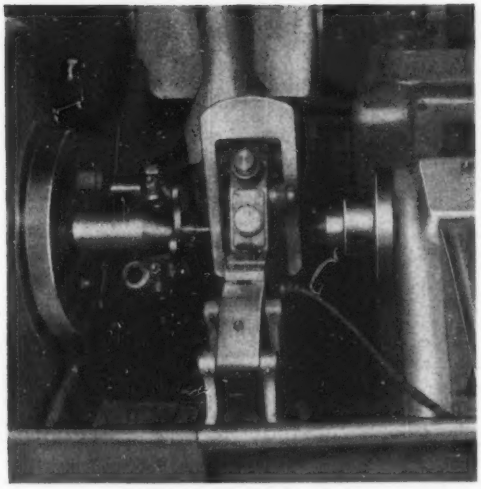


Fig. 2. This Electrically-operated Gauge, on the Schaudt Machine, is Automatically Advanced into Engagement with the Work

of 24 in. diameter, which are run at 900 r.p.m. One wheel is 2 in. wide, and is profiled to grind the 40·031/39·969 mm. (1·5760/1·5736 in.) diameter and the root radius, also the adjacent 28·578/28·565 mm. (1·1257/1·1252 in.) diameter and the shoulder radius. The second wheel, which is 1·5 in. wide, is dressed to grind the 19·053/19·040 mm. (0·7454/0·7449 in.) diameter, and the adjacent radius. No grinding is performed on the taper.

The work is mounted between centres, and is driven at 120 r.p.m. by a pin that engages one of the shaft bosses. When the automatic cycle is initiated, the electric gauge seen in Fig. 2 is advanced to bring a pair of anvils into contact with the parallel portion of the work, adjacent to the thread at the outer end. In-feed is applied to the wheels in increments of 0·0004 in. until the work is within 0·0004 in. of finished size, and they are then automatically reduced to 0·00008 in. After the feed has ceased, there is a controlled dwell, and the wheels and gauging attachment are then retracted, and the machine stops. The machine is one of a group of three, tended by one operator. During the automatic cycle, he lightly re-machines the centre in each component, in readiness for grinding. This operation is performed on a vertical drilling machine.

On the third machine, a burnish-grinding operation is performed on the radius at the root of the shaft portion, adjacent to the flange. Although, on the Schaudt machine, a high standard of surface-finish is maintained, this burnishing operation is introduced in order to minimize the risk of fatigue-cracks developing in service, in this highly-stressed portion of the component. The operation is carried out on a small cylindrical grinder, in which the work is set-up between centres. A specal E. C. E. (German) cork and grit composition wheel of 9½ in. diameter by 1 in. wide is employed. This wheel is dressed with buffing compound and has a rapid polishing action, the amount of material removed being almost imperceptible. At this group of three machines, the combined cycle-time is 0·86 min. per piece.

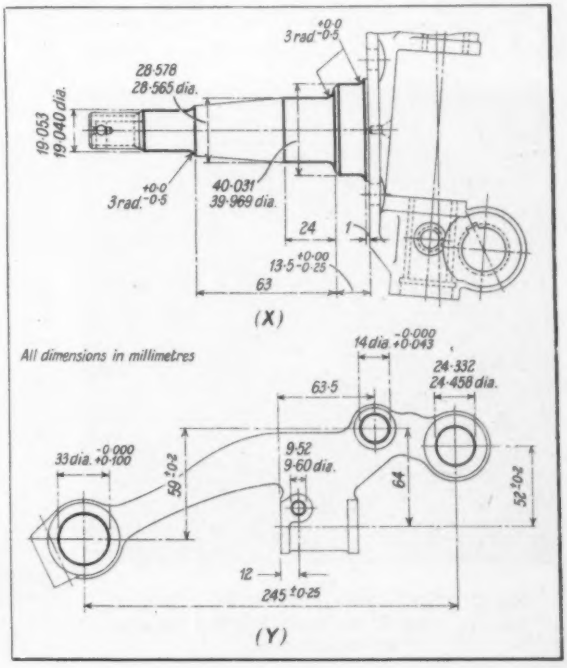


Fig. 3. *X*—Dimensions and Tolerances of the Finish-ground Stub-axle Shaft. *Y*—Knuckle Support Fitting, Showing Dimensions and Tolerances for the Holes Drilled and Reamed at the First Stage

STUB-AXLE SUPPORT FITTINGS

The support fittings, to which the stub-axles are subsequently assembled, are also machined from steel forgings. An indication of the general form of the component is given by the view at Y in Fig. 3, in which the dimensions and tolerances for the first machining stage are indicated. A Hüller special-purpose multi-spindle machine is employed, and is equipped with the 4-station indexing table shown in Fig. 4. There are three working stations, and a loading and unloading station.

At each station, the work is supported horizontally on flat pads, which engage the end bosses, and is positioned against a back-stop at each end. Vertical pins engage the ends of the king-pin boss, and locate the component longitudinally. Two cam-actuated clamps are applied to the end bosses by means of a single hand-lever. When the automatic cycle is initiated, the table indexes, the spindle-head descends until the steady-plate is engaged with four pillars, and the spindles then advance at independent feed rates.

At the first station, there are four drills, of 30 mm. (1·181 in.), 21 mm. (0·827 in.), 12 mm. (0·472 in.), and 8 mm. (0·315 in.) diameter. The 30-mm. and 21-mm. drills are run at 140 r.p.m. and 145 r.p.m., respectively, and machine the holes in the end bosses at a feed of 0·007 in. per rev. The 8-mm. hole, for the king-pin locking-pin, is drilled at 470 r.p.m. and a feed of 0·002 in. per rev., and the 12-mm. drill is run at 265 r.p.m., and fed at 0·004 in. per rev. At the second station, a group of drill-reamers opens-out the holes in preparation for finish reaming at the third station. These drill-reamers are of the following sizes, and are run at the speeds and feeds indicated:—32·6 mm. (1·262 in.) diameter, 74 r.p.m., 0·014 in. per rev.; 23·8 mm. (0·937 in.) diameter, 83 r.p.m., 0·012 in. per rev.; 13·75 mm. (0·531 in.) diameter, 150 r.p.m., 0·007 in. per rev.; and 9·35 mm. (0·368 in.) diameter, 240 r.p.m., 0·004 in. per rev. For the respective reamers at station three, the speeds and feeds are 37 r.p.m., 0·028 in. per rev.; 67 r.p.m., 0·016 in. per rev.; 80 r.p.m., 0·013 in. per rev.; and 100 r.p.m., 0·010 in. per rev.

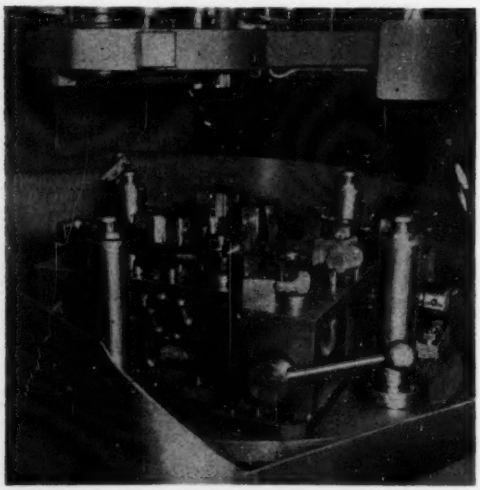


Fig. 4. Close-up View of the 4-station Automatic Indexing Table on the Hüller Machine, Showing the Fixture Design

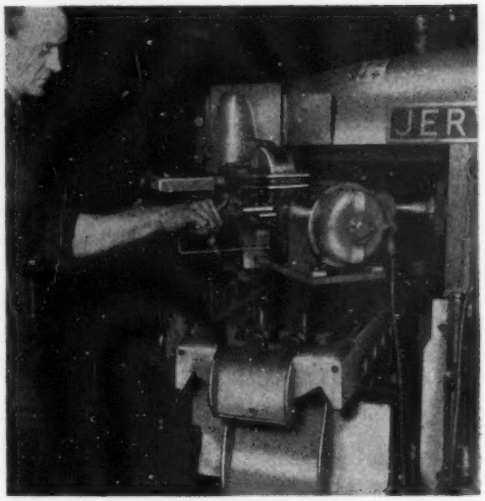


Fig. 5. With this Attachment on a Jerwag Horizontal Miller, the Operator Performs a Countersinking and De-burring Operation During the Automatic Cycle of the Machine

The operator of the Hüller machine also tends the Jerwag horizontal milling machine shown in Fig. 5, on which the work is located by the end bores, and held by an air-operated clamp. A pair of cutters, of 7·9 in. diameter, each with 20 teeth, is run at 28 r.p.m., and is employed to face the ends of the king-pin boss to a length of 51·7 mm./51·6 mm. (2·035 in./2.032 in.) at a feed of 1·7 in. per min. During the cycle of the Hüller and Jerwag machines, the operator also de-burrs and countersinks the holes in the drilled and reamed components, with the special attachment on the Jerwag machine, seen in use in Fig. 5. This attach-

ment comprises an f.h.p. electric motor and reduction-gear, mounted on the overarm brace. The motor drives a horizontal spindle mounting a 90-deg. conical cutter, and, on either side, there are parallel rods, on which a lever-operated pad slides. This pad is used to press the work squarely against the revolving cutter. For this group of machines, the combined cycle-time is 1·9 min. per component.

MACHINING THE KING-PIN BORE

Next, the king-pin hole is machined to 19·012 mm./18·991 mm. (0·7489/0·7481 in.) diameter on a type KST, Herman Kolb multi-spindle automatic machine, equipped with the 6-station indexing table unit and tooling shown in Fig. 6. There are four groups of spindles, and loading and unloading are carried out at one of the two idle stations. At each station, the work is located at the lower end by the 33-mm. diameter bore, which is engaged with a pin that projects horizontally from the body of the fixture. The upper end is located laterally by a profiled recess which embraces the king-pin boss. Two small plungers, sliding horizontally in the body of the fixture, are actuated through a cam and linkage system, by means of a hand-operated shaft. These plungers are advanced into the locking-pin hole, from opposite sides, and a horizontal latch-bar, pivoted to the body of the fixture, is swung across, into engagement with a spring-loaded pawl. In the centre of this latch-bar, there is a screw, which is tightened against the edge of the component.

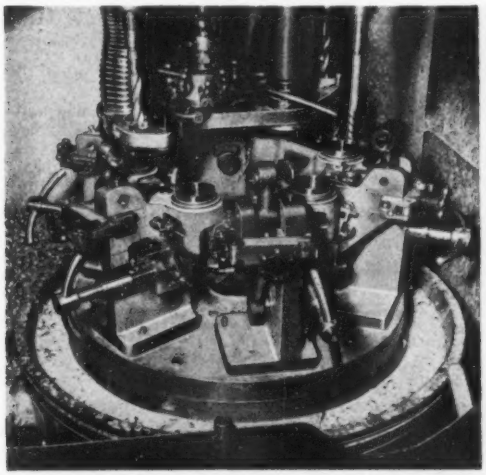


Fig. 6. View of the Table of the Herman Kolb Machine, Showing Details of the Fixtures

The fully-automatic cycle of the machine is repeated continuously. At the first station, an 18-mm. (0·709 in.) diameter drill, run at 270 r.p.m., is fed at 0·005 in. per rev., to half the total depth, and the hole is completed by a similar drill at the second station. Next, a spiral-flute drill, run at 210 r.p.m. is applied to chamfer the hole at 30 deg., to a depth of 1·5 mm. (0·060 in.). At the fourth station, the spindle carries a reamer of the fine-pitch spiral type, which is run at a speed of 100 r.p.m., with a feed of 0·003 in. per rev. A machined component is unloaded every 1·40 min.

The operator of this machine also de-burrs the work, on a vertical drill, and another hones the king-pin bores of certain components, on a Delapena machine. Honing is employed as an economy measure. The spiral reamers used on the Kolb machine are fairly expensive, and, without recourse to honing the work, each reamer has a total useful life of 200 components. By keeping it in service for a further period, and honing the holes when they become undersize, a further 200 components can be reamed.

TAPPING OPERATIONS

Following a series of simple drilling and tapping operations for the stop-bolt holes, and the locking-bolt hole in the boss adjacent to the 33-mm. (1·3-in.) diameter bore, the 24·332/24·458-mm. (0·958/0·963-in. diameter hole is tapped to 1 in. diameter, by 11 t.p.i. For this purpose, a set-up on a Herbert 3-spindle vertical drill is employed, and one operator attends all three stations, at each of which there is an identical fixture. Each fixture comprises a flat plate, supported on three legs at a suitable height above the machine table, to which it is bolted. Three datum-pads on the plate support the work horizontally by the three main bosses, and that beneath the hole to be threaded has a clearance-hole for the tap. The other two pads are provided with locating-pegs, which engage the corresponding bores. The method of tapping, it may be noted, eliminates the necessity for clamping, and loading and unloading are therefore facilitated.

On the rear of the plate, where it projects beneath the machine spindle, there is an arm which overhangs the hole to be tapped, and this arm carries an internally-threaded bush. The thread is of the same pitch as that of the tap, but the diameter is greater, to provide clearance. The fixture is arranged with the bush vertically beneath the drill spindle, and to enable the work to be tapped in a single pass, the tap has taper and full-diameter portions. It is mounted in a holder

which has a threaded portion, corresponding to that of the bush.

Running at 74 r.p.m., the spindle is lowered manually, in the normal manner, until the thread of the holder engages that of the bush, and it is then advanced at the required pitch. When the tap has entered the work to the required depth, the spindle is reversed automatically. Once the screw on the tap holder is clear of the bush, withdrawal of the spindle and tap is effected automatically by the normal spindle return spring. When all three spindles are in use, a tapped component is unloaded every 0·18 min. This output exceeds normal production requirements, so that it is only necessary to run the set-up intermittently, and the operator can be released periodically for other duties.

Next, the locking-bolt boss adjacent to the 33-mm. (1·3-in.) diameter bore is slit, and one end of the boss is faced to provide a seating for the bolt-head, at a shuttle-milling set-up on a Herbert horizontal machine. Two components are held in each air-operated fixture, and are machined simultaneously in a cycle time of 0·68 min.

At the last machining stage in the sequence, the ends of the king-pin boss are milled to give a length of 50·875/51·000 mm. (2·003/2·008 in.) by means of another shuttle-milling set-up, on a Sundstrand horizontal machine. At this set-up, a single cutter is employed, and two components are machined on one boss face at a time, in two passes. At each station there are two simple fixtures, and each fixture incorporates a horizontal expanding mandrel, which locates one component by the king-pin bore. These mandrels point inwards, towards the centre-line of the table, and are arranged above and below the axis of the cutter-arbor, in order to afford the necessary clearance between the components. For the first pass, the work is located axially on the mandrel by a reference-face on the mandrel support. For the second stage, it is transferred to the fixture at the opposite end of the table, where it is loaded on to the mandrel the reverse way round, so that it is located by the face that was machined at the first pass. With this set-up, two machined components are unloaded every minute.

DE-BURRING STATION

At the end of the machining line, there is a de-burring station, a general view of which is given in Fig. 7. This set-up affords a good example of the manner in which the company maintains high productive efficiency, by the use of the M.T.M. time and motion study system. Five stations are arranged on a semi-circular table, and mechanical aids provided include two horizontal power-driven spindles, a Desoutter drill-gun, two Ingersoll power nut-runners, and conveniently-placed, well-designed racks, for small components.

Operations performed at the first four stations are as follows: de-burr ends of king-pin holes, with a rotary file mounted in the Desoutter drill-gun; de-burr ream locking-pin and king-pin holes, with reamers mounted in the horizontal power spindles; and insert locking-bolt at slit end, with a power runner. At the fifth station, another power runner is mounted, inverted, beneath a hole in the bench-top, adjacent to a rack containing nuts and bolts. The nuts are run on to the bolts with the aid of the unit beneath the bench, and the bolts are inserted in the stop-bolt holes, and are run-in sufficiently to retain them during subsequent handling, with the second runner. As

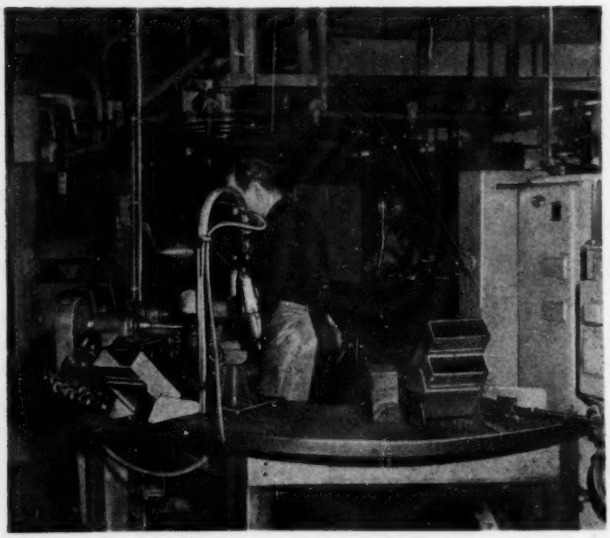


Fig. 7. At This Station, One Operator Performs Three De-burring Operations, and Two Assembly Operations, in a Floor-to-floor Time of 1.2 min. per Component

may be observed, the latter is suspended over the bench. The average sustained performance, by one operator, is four operations per min., and the stage is completed on each component in a floor-to-floor time of 0·92 min.

As the fully-machined stub-axle and support fittings are delivered at the ends of their respective lines, they are placed on an overhead conveyor. This conveyor forms part of a two-circuit system, in which one circuit lies within the other. Both circuits pass through an automatic cleaning plant, supplied by A-B. Mekano, Hälsingborg, Sweden, and at the stage here considered, the work is loaded on to the outer circuit. Cleaning involves three stages, namely, hot soda-solution wash, at 70 deg. to 75 deg. C.; cold-water rinse; and anti-rust oil, at 40 deg. to 50 deg. C. After they have been cleaned, the components are carried to a station where they are unloaded from the conveyor, and checked for cracks by the Magnaflux method. When they have been checked, they are placed on the inner conveyor-circuit, which carries them to the inspection and assembly sections.

ASSEMBLY ARRANGEMENTS

In the complete stub-axle assembly, a roller thrust bearing is interposed between the lower face of the king-pin boss on the support fitting, and the corresponding face on the stub-axle. Shims are inserted between the corresponding upper faces to obtain the correct working clearance. To determine what shims are required, one component of each type is set-up on the equipment shown in Fig. 8, which was developed by the company.

The fixture body comprises a main vertical plate, electrically welded to a flat base-plate, and a large-diameter dial-gauge is mounted on the vertical portion. The plunger of the dial-gauge contacts the flat upper end of a vertical member *A*, which is held upright by a cylindrical extension on the lower end. This extension is free to slide vertically in a hole in a flat plate that projects horizontally from the front of the body. Pivoted to the lower end of the member *A*, at a point just above the extension, there is a rocker *B*. Each end of the rocker is connected by a pivot to a vertical plunger, and these plungers are free to slide in bushes in the horizontal plate. On the lower end of each plunger, there is an anvil, and the ends of the rocker are spring-loaded downwards.

Immediately below the right-hand plunger, and mounted on the main upright plate, there is a corresponding lower anvil. The king-pin boss of the support fitting is inserted in the gap between the anvils, with the thrust bearing interposed between the boss and the lower anvil. At the left-hand side, the fixed anvil is mounted on the upper face of the horizontal plate, and the fork of the stub-axle fitting is passed over it, and the corresponding plunger anvil.

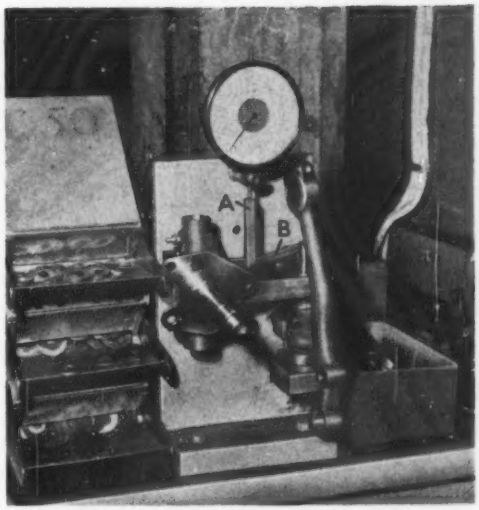


Fig. 8. This Differential Dial Comparator, Developed by the Company, is Employed to Facilitate the Selection of Three Different Thicknesses of Shims. A Comparison is made between the Thickness of the Boss on the Support and the Gap-width of the Stub-axle Fork

With this arrangement, the measurement over the boss and thrust bearing is directly compared with the width of the gap in the stub-axle. Shims for adjusting the working clearance are of three thicknesses—0·5 mm. (0·02 in.); 0·35 mm. (0·014 in.); and 0·10 mm. (0·004 in.). The face of the dial-gauge is divided into three concentric circular zones, which correspond to these thicknesses. Radial lines subdivide the zones into sectors, and, inscribed in these sectors, there are various numerals. For any given reading of the pointer, the numerals in the three sectors directly denote the number of shims of each size which must be used. With this equipment, the shim requirements for each set of components are ascertained in a floor-to-floor time of 0·70 min.

ASSEMBLY RIG

The matched components are temporarily fastened together in sets, which are passed to the assembly rig shown in Fig. 9. Here, the support

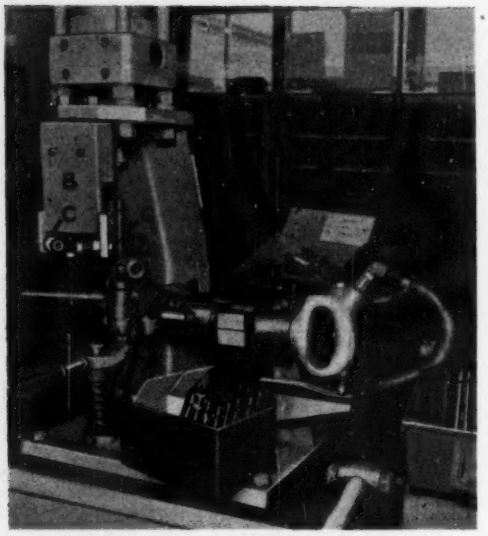


Fig. 9. On this Semi-automatic Rig, an Assembly is Completed in a Floor-to-floor Time of 0.8 min. The Stub-axle Assembly is Clamped Pneumatically and the King-pin is Inserted by an Air-Ram

fitting is located by two pegs on the main body of the rig, which engage the end bores, and align it so that the king-pin bore is vertically below a pneumatic ram. Another air-cylinder, mounted horizontally on the left-hand side of the body of the rig, serves to clamp the fitting against datum-pads. The ram of this cylinder is withdrawn, for loading, by depressing a pedal, and advances when the pedal is released. A stub-axle is placed on the pivoted, lever-operated member *A*, which has a spigot to engage the lower king-pin bore, and the fork is passed over the boss on the support fitting by swinging the member about the pivot. This member is spring-loaded upwards, so that the stub-axle can align itself with the boss on the support fitting, and this feature also facilitates insertion of the shims, which are next placed in position, followed by the thrust bearing.

The king-pin is then inserted in the upper boss of the stub-axle and is driven home by the vertical pneumatic ram, which is controlled by a second pedal. When this ram descends, a slide *B*, carrying a pair of adjustable screw stops *C*, is also moved down. In the lowered position, these stops are aligned with the heads of the travel-limiting stop-bolts of the support fitting, the settings of which are thus checked, so that any necessary adjustment can be made. Next, a locking-pin is inserted in the support fitting, and a third pedal is depressed. Thereupon, the riveting-hammer, seen in the illustration, is advanced by an associated horizontal air-cylinder, and the pin is driven home. At this set-up, each assembly is completed, and the stop-bolts adjusted, in a floor-to-floor time of 0·8 min.

At another rig, end-caps are pressed into the king-pin bosses in a floor-to-floor time of 0·31 min. per assembly, and, finally, at a 4-station bi-manual set-up, the eccentric bush for adjusting the camber-angle, and a stud for the hydraulic damper, are assembled. At this set-up, the work is held in simple wooden nest-type fixtures, and power runners are provided. This stage is completed on each assembly in a floor-to-floor time of 0·57 min. Finally, the assemblies are treated with anti-rust solution, in readiness for despatch.

A TITANIUM MELTING FURNACE, stated to be the largest in Europe, was recently put into operation at the Kynoch Works of I.C.I. Metals Division, Witton, Birmingham. This furnace is one of three furnaces which have been supplied to the Division by W. C. Heraeus G.m.b.H. (Western Germany) for the production of double-melted ingots, of weights up to 4,200 lb., by the consumable electrode arc melting process. The furnaces were delivered in January and the first 1-ton ingot was produced about two months later. Within a few days, an ingot weighing 4,200 lb.—said to be the largest ever produced outside the U.S.A.—was successfully melted.

It is pointed out that the availablity of large ingots widens the scope of fabricating techniques which can be applied to tintanium. In particular, it permits of rolling slab into long-length coils without the necessity for welding small coils together. In addition, yield is increased because the surface/volume ratio is reduced. Any saving in process scrap is, of course, important, because titanium is still a relatively expensive metal.

The furnace will normally operate with a high degree of vacuum, a pressure of under 10 microns being maintained throughout a melt. Facilities are also provided for melting under a reduced pressure of an inert gas, if required.

Although it is less than three years since I.C.I. commissioned the first titanium melting plant in this country, technical knowledge has accumulated so rapidly that the entire complement of melting furnaces has twice been replaced. In 1955, 18 furnaces were needed for an output of 1,500 tons per year, whereas today, three are sufficient to produce more than 2,000 tons per year.

Machining Operations on Alignment Telescope Barrels

By A. BLANKEN*

With the need for maintaining progressively closer tolerances in many fields of metal working, optical equipment is assuming constantly increasing importance. With this equipment, a line can readily be established in space which is perfectly straight, has no weight, and is unaffected by variations in temperature. From such a line, measurements can consistently be made over short or long distances with an accuracy which is as close as 0·001 in.

Optical alignment equipment has been successfully employed for a considerable time in connection with aircraft manufacture. More recently, it has been applied with equally good results to atomic energy plant, machine erection, missile manufacture and launching, shipbuilding, and ordnance production.

Because they must enable accurate measurement to be taken, the optical instruments must be made to unusually close tolerances. One basic instrument is the alignment telescope, which provides an accurate optical reference line centred on the mechanical axis. Alternatively, in conjunction with an optical square, such an instrument can establish a right angle accurate to ±1 sec. of arc (0·001 in. at 16 ft.).

* Special Devices Department, Keuffel & Esser Co., U.S.A.

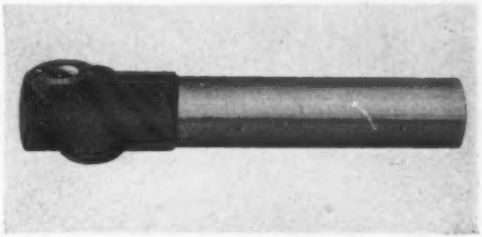


Fig. 2. The Precision Barrel for an Alignment Telescope. Sighting and Focusing Knobs are Mounted on the Bosses at the Rear End (left)

Supported either on V-blocks or in a spherical adapter, the alignment telescope and optical square combination can be rotated to sweep out a plane at right angles to the axis. It will be evident that for this latter application, the outside diameter of the telescope barrel is of critical importance. The inside diameter is also critical, since it determines the positioning of the optical-mechanical system, and the bore must be both concentric with and parallel to the outside surface.

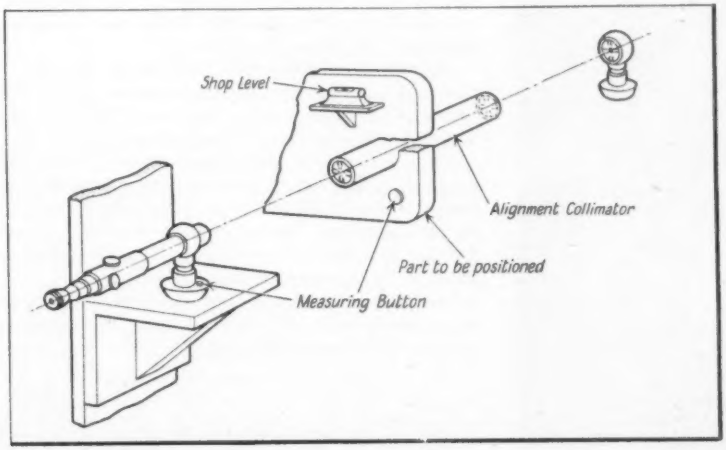


Fig. 1. The Part to be Positioned Carries a Collimator which is Aligned with the Telescope and Target

The diagram, Fig. 1, shows one method of positioning a part. Here, the instrument is held in a cup mounting, and the part to be positioned carries an alignment collimator, a shop level, and a reference button. Within the collimator there are two targets whereby an accuracy of 0·001 in. is obtained.

The part is positioned by adjusting it until both collimator targets are on the reference line, and

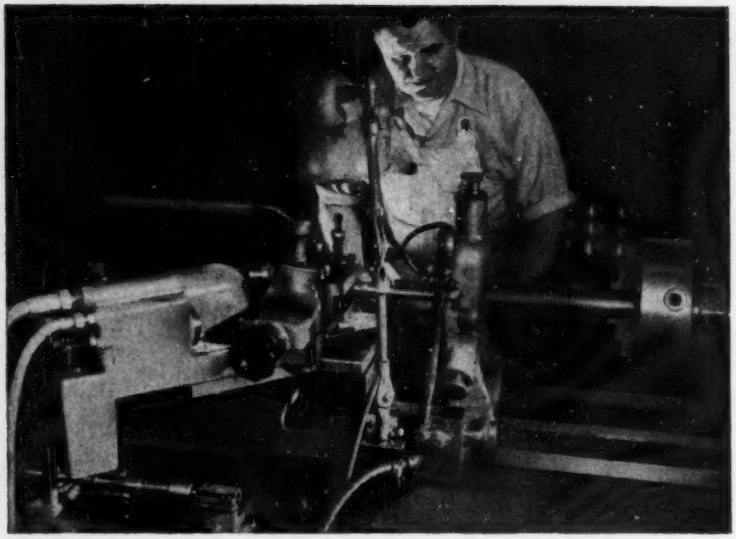


Fig. 3. The Bore of the Barrel is Machined on a Monarch Lathe Equipped with a Tracer Attachment. In the Foreground on the Left may be seen the Stylus and Master

the shop level is used to control the angular position about the established line. Position of the part along the line of sight can be checked by measuring the distance between the reference button on the workpiece and a second button on the cup mounting.

Among the leading suppliers of optical tooling and aligning equipment are Keuffel & Esser Co., Hoboken, N.J., U.S.A., and the methods employed for making the barrel for an alignment telescope at the company's works of the Special Devices Department, Cranford, N.J., are here described. A completed barrel, ready for assembly with the inner tube which carries the lenses, is shown in Fig. 2.

All finish machining and inspection of the barrel are performed in air-conditioned areas where the temperature is maintained within 1 deg. F. The 9-in. plated section must be cylindrical—free from both taper and out-of-roundness—within 0·0001 in.

In practice, both barrel and inner tube must be machined virtually without reference points, since their ultimate quality cannot be gauged until the optical train has been installed. Measurements are relative, within specified limits, to the optical centre of the finished instrument.

Material for the barrel, a high-grade tool steel, is received as trepanned bar stock, with an outside diameter of 2¾ in. and a bore of 1½ in. At the first operation the stock is cut into 14½ in. lengths.

The rear end of the barrel, which houses the eyepiece, micrometer, and focusing knobs, is then rough-turned to 2⅝ in. Next, the part is reversed in the lathe, and the barrel proper, which is later ground and chromium plated, is rough-turned to 2⅜ in. The part is then stress-relieved.

With the work gripped externally and supported in a steady rest, the bore is now machined to receive the inner-tube containing the lens train.

Fig. 4. Set-up for Drilling the Holes for the Sighting and Focusing Knobs. Bosses are Subsequently Silver-soldered in Position over These Holes

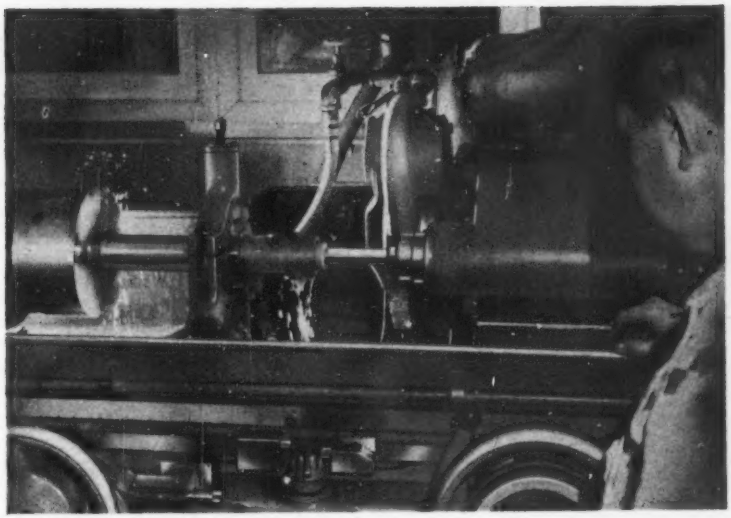


Fig. 5. Grinding the Bearing Surfaces in the Rear End of the Barrel. For the Corresponding Operation on the Surfaces at the Other End, the Work is Gripped Internally by Means of a Chuck Mounted on a Magnetic Faceplate

This operation, seen in progress in Fig. 3, is performed on a Monarch lathe with the aid of a Bondycop hydraulic copying attachment. Two bearing surfaces, a clearance area, and a central chamfer, are machined from one end. The workpiece is then reversed in the lathe, and similar operations are carried out from the other end.

Subsequently, the two outside diameters are again turned. The rear end is reduced to 2½ in. and the barrel proper to 2·280 in. The latter is also undercut to provide clearance for the grinding wheel. With the lathe operations completed, three 1-in. holes are drilled at the rear end for the vertical and horizontal micrometer knobs and the focusing knob.

In addition, nine small holes are tapped to accommodate set-screws for the Micrometer assemblies; two holes are drilled in the barrel to receive locating spherical adapters or an optical square; and another hole is drilled and tapped to receive a screw for locking the inner tube.

One of the knob holes is being drilled in Fig. 4. The operation is carried out on a radial drilling machine with the barrel held in a box jig. A ⅝-in. drill, guided in a slip bushing, is first applied to produce an undersize hole.

Next, a previously-prepared boss is silver-soldered over each knob hole. (The bosses can be seen as part of the completed barrel in Fig. 2.) To locate the boss for soldering, it is slipped over a plug which is placed in the hole.

In practice, the silver-soldering is performed as part of a heat-treatment cycle. With the silver solder applied, the work is heated to 1,450 deg. F., at which point the solder melts. The temperature is then reduced to 1,425 deg. F., so that the solder solidifies, and then the work is quenched in oil. It is then tempered at 600 deg. F. in an open hearth furnace, and stabilized by holding it at a temperature of 40 deg. F. for 12 hours. The cycle ends with a second tempering treatment in the open hearth furnace at 400 deg. F.

The barrel is next ground externally and internally. After chamfers have been ground at both ends, the work is mounted between centres, and the outside surface is ground to within 0·0003 in. of finished size. This surface is then gripped in a 3-jaw chuck, and the barrel is supported at the other end in a steady rest, while the internal surfaces at the rear end are ground to size. Fig. 5 shows the set-up for the operation on a Cincinnati universal grinding machine.

For grinding the two surfaces in the other end of the barrel, the work is reversed in the machine. At this stage the 3-jaw chuck grips the work internally. The chuck is mounted on a magnetic faceplate so that the work can readily be checked with an indicator and set to run dead true.

For the final grinding operation on the outside surface, stub arbors are inserted in the ends of the barrel. The outer end of each arbor has a countersunk hole to accommodate a centre. There is a slight taper on the arbor surfaces which enter the work so that a tight fit is obtained as they are pressed in. The operation is performed on the Fortuna machine seen in Fig. 6. Size is held to 2·2495 inch, +0·0001 in. −0, prior to plating. In the illustration the operator is checking the size with an air gauge.

Machining completed, the outside of the barrel is hard chromium plated, to an average depth of 0·001 in. To enable the close tolerance on this

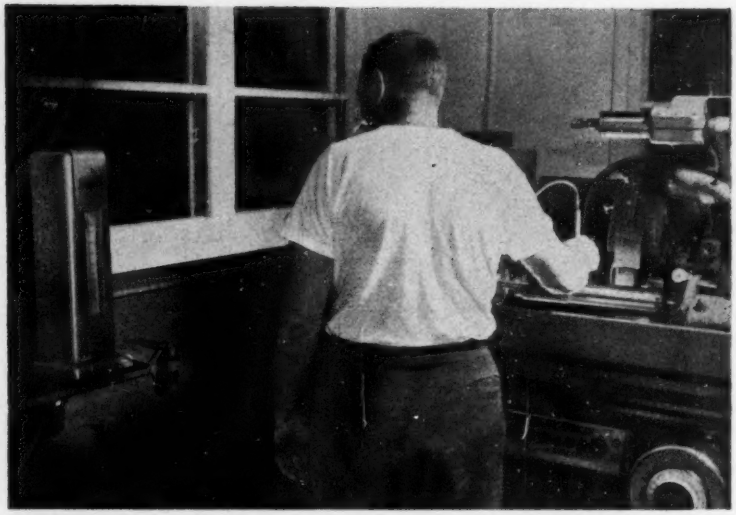


Fig. 6. Checking the Outside Dimension with an Air Gauge Before the Work is Removed from the Grinding Machine. To Enable the Close Tolerance to be Maintained, the Plating Thickness is Specified for Each Barrel

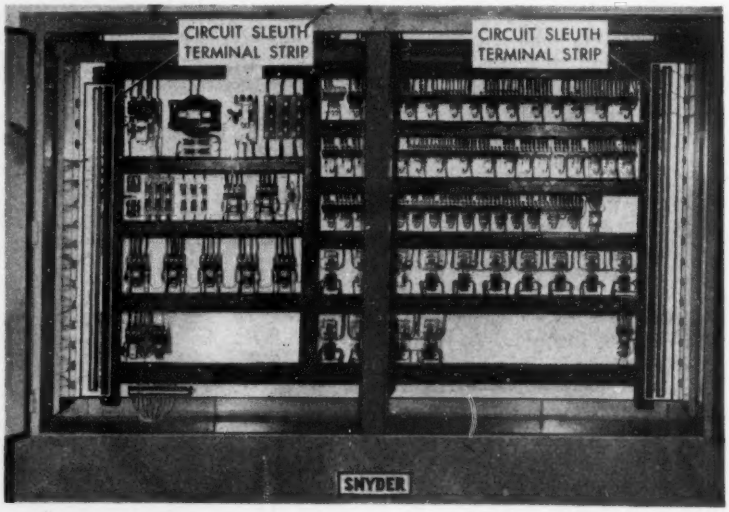
surface to be maintained, each workpiece is measured and the required plating thickness is specified.

All surfaces of the barrel, except those already plated, are then treated by the Parco Lubrize process to obtain a matte and rustproof finish. Finally, the micrometer end is painted and engraved.

The barrels are then ready for consignment to the Hoboken plant. There, the alignment telescopes are assembled and checked with collimators to ensure that the 0·0002 in. line-of-sight accuracy, specified for all instruments, is maintained.

Snyder "Circuit Sleuth" Fault-finding Equipment for Control Panels

Equipment to facilitate the location of faults in intricate electrical control panels has been introduced by the Snyder Tool & Engineering Co., Detroit, Mich., U.S.A. Known as the "Circuit Sleuth," the equipment comprises a number of terminal strips, and associated pilot lights, to which the electrical components in the control panel are connected. A typical installation is shown in the accompanying figure.



Snyder Control Panel Fitted with "Circuit Sleuth" Fault-finding Equipment

The terminal strips can readily be adapted to suit changes in panel design, and can be supplied for all Snyder automatically-operated machine tools.

The Snyder Tool & Engineering Co. are represented here by Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, London, S.W.11.

The Third Production Exhibition—1

The third of the series of Production Exhibitions sponsored by the Institution of Production Engineers will be held in the Grand Hall of Olympia. It will be opened on May 12 by The Rt. Hon. The Lord Mills, Minister of Power, and will continue until May 21. This year the Exhibition, and the conference which will be held concurrently, will have the timely theme "production fights inflation," and attention will be drawn to some means whereby productivity can be increased by the introduction of improved equipment and conditions in factories and offices. Exhibits will be arranged in sections concerned with production control, developments in materials and metals, services and aids to production, research and development, training, and automatic production.

Attention is here drawn to some of the exhibits, and others will be considered in subsequent issues.

Denfords Engineering Co., Ltd., Heckmondwike, Yorks. Stand No. 15, Row G

Exhibits on this stand will include the Box-Ford 4½-in. lathe, seen in Fig. 1, which is fitted with a hydro-pneumatically operated saddle. Known as the type HPS, this machine provides a semi-automatic steplessly-variable sliding feed, and is intended for accurate repetition-turning operations by unskilled labour. As will be observed, there are two piston rods projecting from the right-hand end of the saddle apron casting, and these rods are secured to a bracket which is clamped to the front slideway. The upper rod is connected to the piston of an air cylinder, and the lower to the piston of an oil-filled check cylinder. As the saddle is moved along the bed towards the headstock, by the air cylinder, oil is transferred from one side of the check cylinder piston to the other, through a flow control valve. This valve, and consequently the rate of feed, can be adjusted whilst the saddle is moving. The direction of traverse of the saddle is governed by a hand lever-operated reversing air valve mounted on the front of the apron casting.

The standard length of feed stroke available on this machine is 4 in., and this amount of movement can be obtained at various positions along the bed by moving the piston rod anchor bracket. Provision for longer strokes can be made, to order. Diameters up to 5¾ in. can be swung over the cross slide, and the lathe will admit 16 in. between centres. There are low and high ranges of spindle speeds, from 38 to 1,300 and 76 to 2,600 r.p.m. Extra equipment available for this lathe includes a hand-lever operated tailstock, plain and micrometer-type saddle stops, a draw-in or dead length collet attachment, a taper turning attachment, and contour turning equipment.

In addition, the 8-in. stroke Box-Ford shaping machine, which was described in MACHINERY, 90/193—20/7/56, will be shown. This 4-speed machine is intended for toolroom, technical college, and apprentice training work. It has a 6-in. wide by 7½-in. long work-table, and the tool-head, which can be swivelled through 90 deg. on either side of the vertical, has a travel of 3½ in. Other machines will include the type A, 9-in. swing lathe, and the 1-in. capacity collet, plain, precision instrument lathe, which has steplessly-variable spindle speeds up to a maximum of 2,000 r.p.m.

Fig. 1. The Box-Ford HPS Lathe with Hydro-pneumatically Operated Saddle

Among the Union range of engineers' accessories to be displayed, may be mentioned bench testing centres, with capacities from 4½ to 18 in.; an 8-ft. by 3-ft. marking-out table; surface, swivel, and angle plates; tilting tables; and drilling and machine vices. Box-Ford shock-proof gauges and stands will also be represented.

Alfred Herbert, Ltd., Coventry. Stand No. 16, Row D

A selection from the wide range of measuring equipment marketed by the company will be displayed, and will include the Hilger Chekker projector seen in Fig. 2. This instrument is suitable for general or quantity-production inspection, and can be operated in the horizontal (as shown) or vertical position. A variety of standard work holders and centre mounts is available, also a number of special fixtures to facilitate the inspection of quantity-produced components. Among other Hilger products to be shown, may be mentioned the latest universal projector, which is suitable for average toolroom and inspection department work, and will be displayed with a full range of auxiliary equipment. There will also be Watts instruments for measuring lengths, angles, alignments, flatness, straightness, and surface finish, together with the Microptic measuring machine, which is available in vertical and horizontal forms, the latter having a projection screen.

The new Model-100 Taylor-Hobson Talysurf portable surface-measuring instrument is comparable with the well-known standard type, as regards accuracy and repeatability of readings. It is claimed that this instrument can be used by unskilled labour and requires virtually no setting.

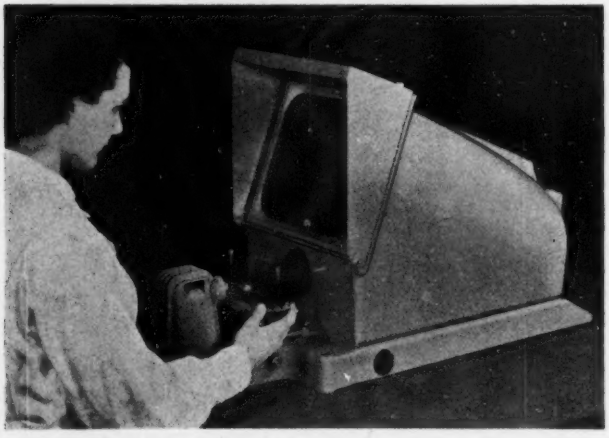


Fig. 2. The Hilger Chekker Projector

Several Sigma vertical mechanical comparators will be shown, with a range of auxiliary equipment, and a Sigma effective-diameter measuring machine and a bench micrometer will be demonstrated. In addition, there will be examples of Matrix equipment, including a height setting micrometer and internal thread and optical twist drill comparators.

Fletcher Miller, Ltd., Alma Mills, Hyde, Cheshire. Stand No. 13, Row J

To draw attention to the range of cutting fluids supplied by this company, and their applications, a number of interesting machining set-ups will be featured, each of which will be presented in the form of a case history for a particular part. Specimen components, taken from actual production runs, will be available for inspection, in addition to the cutting tools used, details of the cutting fluid employed in each case, and information concerning the advantages obtained.

Electro-Chemical Engineering Co., Ltd., Sheerwater, Woking. Stand No. 16, Rows G and H

A typical spray washing machine made by the company is shown in Fig. 3, and the main feature on this stand will be a 2-stage spray washer designed to handle motor car engine components. The washing section of this machine incorporates a full length belt-type filter capable of passing 150 gal. per min., and of retaining particles down to 5 microns. This filter receives the full flow of the cleaning solution as it returns from the spraying system, thus ensuring efficient cleaning and eliminating the risk of blocked nozzles and the need for manually de-sludging the tank. Other features of this washer include the use of totally-submerged pumps, which obviate gland leakage and exposed pipes; automatic cleaning solution level control; easy access to the stainless-steel spraying nozzles; and thermal insulation of the tanks and canopies.

Demonstrations will be given with Zero-mist additive, which suppresses the mist and spray normally associated with chromium plating processes. Attention is drawn to the fact that exhaust systems are not required for chromium plating installations when this additive is used, and that the Factory Regulations have been amended in this respect.

The Agidip Mk. III metal cleaning unit, which will also be shown, is designed primarily as a washing

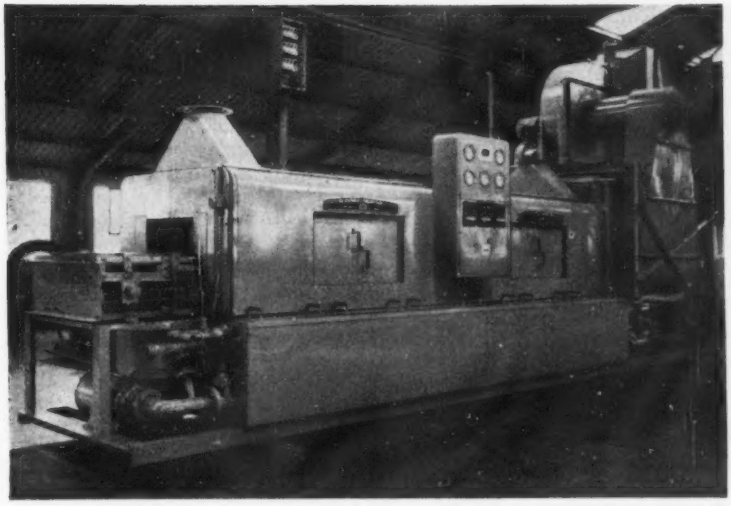


Fig. 3. A Typical Efco Spray Washing Machine

machine, but can be used for oil-quenching and similar operations. This unit can be used singly, or in batteries of two or more, to provide multi-stage sequences, and an automatic transfer mechanism is available.

The new Efco-Hendor filter will be demonstrated, also a typical Efco-Udylite fully-immersed barrel unit, which is suitable for electro-plating small components by a wide variety of processes. In addition there will be a display of parts plated in Efco-Udylite bright nickel, and subsequently coated, to a greater thickness than is customary, by a modified chromium-plating process. Parts treated in this manner, it is stated, have substantially improved resistance to corrosion.

Grauer & Weil, Ltd., 3/4 Hardwick Street, Clerkenwell, London, E.C.1. Stands No. 15 and 16, Row F

Two new filters for electro-plating solutions, which will retain micron size particles, will be shown. Of large capacity and surface area, these units are said to require the minimum of maintenance. There are two sizes, with capacities of 1,750 and 800 gal. per min. Each incorporates a motorized centrifugal pump, and filtering is effected by means of paper pads. The filters have been available on the Continent for a number of years, but have not hitherto been exhibited in this country.

A new electro-plating barrel unit will be on view, also a plating tank fitted with electrical clamps and spring clip connections of a new type, for the anodes and conductors. These clamps and connections provide positive contact and facilitate assembly and dismantling.

Various polishing compositions in bar form will be shown, as representative of a range available for use with modern automatic polishing machines, also liquid-type polishing compositions and spray gun equipment. The latter will be set up for use with a variable-speed polishing lathe, for which the company has recently acquired the sole agency in the United Kingdom.

Reference may also be made to the Paraflow mop, which is claimed to have good cutting and finishing properties, and can be supplied in forms to suit many different work profiles.

Shell Chemical Co., Ltd., Marlborough House, 15/17 Great Marlborough Street, London, W.1. Stand No. 13, Row F

This stand will be in the " Production in Metals " section of the exhibition, and a range of Epikote resins and curing agents will be on view. Attention will be drawn to the manner in which plastics materials can be used in place of steel for many tooling applications in the engineering industry, and to the extent of the economies which can thus be effected.

To indicate the range and capabilities of tools made from these resins, there will be drilling jigs, checking fixtures, vacuum forming moulds, press tools, and foundry patterns. Other exhibits will be concerned with " plastic metals," incorporating Epikote resins, which are employed for such purposes as stopping in motor car body work and filling blow holes in castings.

Letchworth Components, Ltd., Works Road Letchworth, Herts. Stand No. 27, Row H

On the Gazelle projector seen in Fig. 4, the cross-beam can readily be adjusted to suit the helix angle of a thread by releasing a single screw. The lenses used form a complete system for gauge

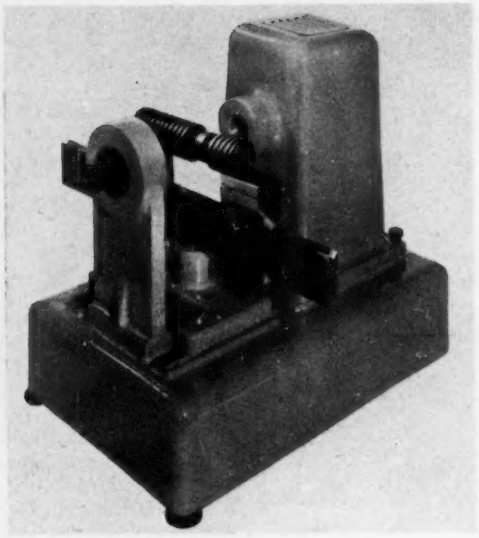


Fig. 4. Gazelle Optical Projector

projection, and the focusing and vertical slide adjusting screws are located in the base casting, to permit uninterrupted access to the work mount for loading and unloading. Threaded components of 2-in. diameter by 9 in. long can be accommodated between centres, and the V-blocks, which are fitted with male and female centres, are mounted on steel balls and can be moved either independently, or as a unit.

Light is provided by a 100-watt lamp, and a projection screen can be supplied, for floor- or wall-mounting. Diagrams are available for Whitworth, B.A., Metric, and U.N.F. thread forms, and special profiles can be supplied to customers' individual requirements.

The Gazelle Major optical projector, which was described in MACHINERY, 92/498—28/2/58, will also be shown. Designed for use in a horizontal or vertical position, this projector is fitted with a lens system providing magnifications of 10×, 25×, 50×, and a 100×.

E. Leitz (Instruments), Ltd., 20 Mortimer Street, London, W.1. Stand No. 13 Row C

The range of Leitz optical instruments to be shown on this stand will include the new Ultra-Projectometer seen in the accompanying Fig. 5. This instrument incorporates an optical system providing an amplification of 10,000:1, and a long range scale graduated in 0·000005-in. divisions, which is read visually on an illuminated screen. Intended for such applications as checking gauge blocks, plug gauges, thread measuring wires, and components for miniature bearings, this instrument is claimed to have an inherent accuracy of 0·000002 in. There is a plunger in the measuring head, which, when brought into contact with the specimen, causes a mirror to tilt. Since the measuring screen is projected by this mirror, the tilting action causes the measurement to be indicated on the scale of the projection screen. It may be noted that the tube which carries the measuring head and plunger is of double-wall construction, to provide the maximum protection against temperature fluctuations. Several different designs of specimen tables are available for use with this instrument, and a special fixture can be supplied for holding gauge blocks for comparison measurement.

This instrument is intended for installation in a temperature-controlled room, and, in addition, a protective housing is available to insulate the body of the unit against external heat.

A feature of the Leitz optical dividing head, which will be on view, is the use of spherical-type ball bearings for the dividing head spindle. Details of these bearings were included in a description

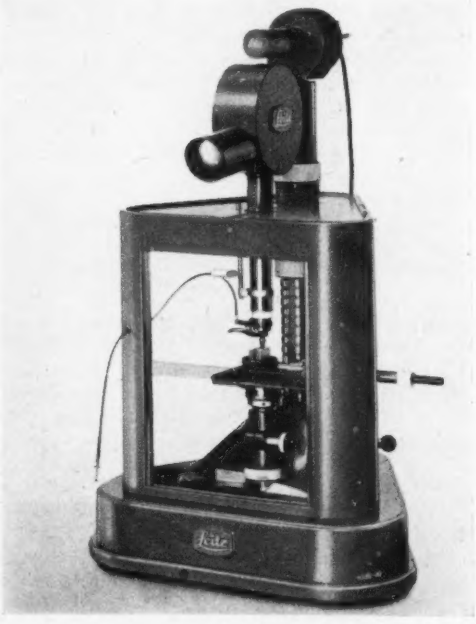


Fig. 5. Leitz Ultra-Projectometer

of this instrument which was published in MACHINERY, 88/145—20/1/56, and it is stated that owing to their free-running characteristics, and the fact that the load is distributed over a large number of balls, accuracy is maintained over long periods.

The optical system is so arranged that readings taken at two diametrically-opposed points appear simultaneously in the eyepiece, and because these readings are matched, a plus error on one side of the scale and a minus error on the other are equalized, so that compensation is provided for any lack of concentricity in the master dividing circle. Among the attachments available for use with this instrument is a motorized driving unit, which enables the workpiece to be turned, prior to dividing operations, thus eliminating the need for re-setting.

Mention was made in MACHINERY, 91/602—13/9/57 of the Leitz Perflectometer, which enables parallel, taper, and profiled bores to be measured with a high degree of accuracy. This instrument operates on purely optical principles, the surface of the workpiece being used as a mirror on which a line mark image is projected by a pencil of light rays. It is not necessary for the surface to be highly polished, as even a matt finish will provide sufficient reflection. The overall accuracy is stated to be 0·000012 in., and the instrument is suitable for checking such components as parallel and tapered ball-race bores.

Another recently-developed instrument which is being exhibited is a drawing-die microscope, for measuring the diameter of a die bore, the length, and the angle of taper of the conical portion. It incorporates two microscopes, mounted in a turret which is arranged for rapid indexing.

Among other measuring instruments to be shown, may be mentioned the Miniload micro-hardness tester, which has a load range from 15 to 2,000 gm.; and the UWM toolmakers' microscope. The latter was described in MACHINERY, 91/696—20/9/57, and is a development of the Leitz WM11, with an increased measuring range. It may be noted that the company's Tolerator optical comparator, which was originally developed for external work only, has now been fitted with a special stand so that it can also be used for internal work.

A boxed set of fused quartz block gauges will be shown, and among the advantages claimed for this material, as compared with steel, are the low coefficient of expansion, and its resistance to plastic deformation. Quartz gauges can be wrung together in the normal manner, and, since they are transparent, any lack of overall, intimate contact between the two pieces is immediately made apparent by the presence of interference fringes. Boxed sets of 116 pieces, up to a maximum of 25 mm., are available, and reference grade sets in English sizes, up to a maximum of 1 in., may be produced in the future.

Almco Supersheen Division of Great Britain, Ltd., Bury Mead Works, Hitchin, Herts. Stand No. 22, Row H

In two articles in MACHINERY, 90/867—19/4/57 and 90/923—26/4/57, a full description was given of Almco Supersheen barrel-finishing, and of the

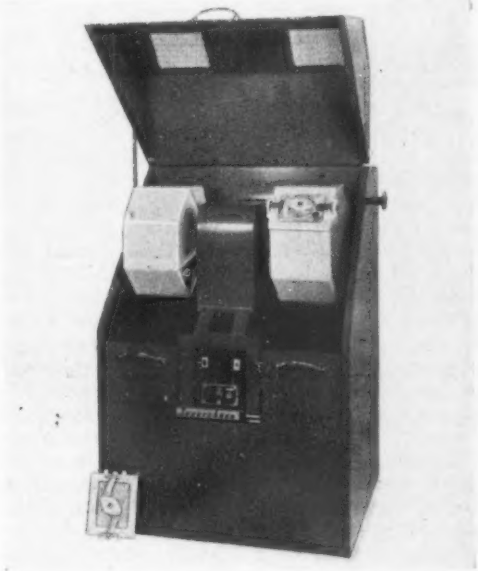


Fig. 6. Almco Supersheen Type DBO.1A Barrel-finishing Unit

equipment and materials which are supplied by the company for this purpose. This stand, and the machines exhibited thereon, will be arranged to simulate, as closely as possible, the actual working conditions of a factory installation, even to the extent that a gully will be provided for the collection and disposal of the process effluent from the larger of two machines—a type DB.50. The barrel of this machine, which is 24 in. wide and is divided into two compartments, has a capacity of 5·6 cu. ft.

Each of these compartments is rubber-lined, and the barrel doors are of cast aluminium with quick-acting cam-lock catches. A 5 to 30 r.p.m. variable-speed drive provides for rotating the barrel.

The other machine to be demonstrated is the type DBO.1A, shown in Fig. 6, which has a sump incorporated in the base member, whence the process effluent is discharged direct to a normal drain by way of a 2-in. diameter pipe. This machine has two separate barrels, mounted on a common shaft with a speed range of 5 to 40 r.p.m., and the total capacity is 2 cu. ft. These barrels, also, are rubber-lined, and the doors and locks are similar to those of the large machine.

Both machines will be employed for quantity production finishing of components which are being lent by users of Almco equipment and materials.

Aylesbury Turned Parts (True Screws), Ltd., Britannia Works, Britannia Street, Aylesbury, Bucks. Stand No. 26, Row H

This company will show a representative selection of turned parts, in various materials, made on capstan lathes and automatics, with emphasis on components which have been made for the aircraft industry. Various Helios measuring instruments will also be displayed including a new vernier caliper with a hinged jaw, and the dial caliper, which was described in MACHINERY, 88/644—4/5/56. The latter incorporates a dial indicator, graduated in 0·001-in. divisions, in place of the conventional vernier scale, the pointer of this indicator being secured to a pinion which engages with a rack extending along the body of the instrument. Two sizes are available, with 5 and 10 in. measuring ranges, and with English or Metric markings. This instrument is suitable for inside, outside, and depth measurement, and a base attachment is available whereby it can be converted for use as a height gauge.

Some applications of Flexidur plastics belting, which is particularly intended for high-speed drives, will be illustrated.

C. C. Wakefield Co., Ltd., 46 Grosvenor Street, London, W.1. Stand No. 9, Row D

The theme of this stand will be the application of Wakefield-Dick oils, lubricants, and lubricating equipment to quantity production processes, and the display will be divided into three sections. The first will be concerned with the activities of the company in the field of nuclear power, and the second with those oils which are used in high-production engineering. Typical workpieces which have been machined with the aid of the company's cutting oils will be included, also a series of photographs of machining operations in progress.

The third portion of the stand will be devoted to mechanical aids for the application of lubricants and cutting oils, such as mechanical oil and grease lubricators which automatically deliver metered amounts of lubricant to various points on a machine, Ayrlyne lubricators, and transportable oil dispensers.

A newly-introduced item, which will be on view, is a soluble oil mist sprayer. This unit delivers a fine mist of coolant in a jet of compressed air, which offers advantages, in certain circumstances, over more conventional methods of application.

A recently-issued Wakefield-Dick publication entitled "Getting to Know the Nuclear Power Station" will be on display.

Mawdsley's, Ltd., Dursley, Glos. Stand No. 2, Row B

On this stand there will be a representative selection from the company's range of A.C. "stop clutch" motors, the operation of which was described in MACHINERY, 89/1173—23/11/56. A self-adjusting combined clutch and brake unit is incorporated, and the arrangement is such that, when the motor is started, the rotor is moved axially, by magnetic force, to bring the conical members of the clutch into engagement. When the current supply to the motor is interrupted, the rotor returns to its original position, so that the clutch members are disengaged. At the same time, the conical members of the brake are brought into contact by means of compression springs.

This braking action enables the disengagement of the drive to be controlled very accurately, so that drills, for example, can be brought close to the surface of a workpiece under rapid traverse. Consistent stopping of one of these motors will be demonstrated.

Thomas Mercer, Ltd., St. Albans, Herts. Stand No. 15, Row A

A detailed description of the Airmatic automatic sizing control for grinding machines, which has been developed by this company, has already been published in MACHINERY, 92/1008—2/5/58, and demonstrations of the equipment fitted to a Karstens cylindrical grinding machine will be given on this stand. Control of the work-sensing calipers, for feed on to, and withdrawal from, the workpiece, is completely automatic, and provision is made for connecting the equipment directly to the existing hydraulic circuit of the machine.

There are four basic types of control units, namely, the Mark I, which is a plain 2-stage controller; the Mark II differential controller, for use where it is required to match the size of a shaft with the bore of a completed component; the Mark III, 3-stage controller; and the Mark IV, which is a combination of the Mark III and the differential type.

The Sixth Mechanical Handling Exhibition—2

Cable Covers, Ltd., St. Stephens House, Westminster, London, S.W.1. Stand No. 238, First Floor

The patent Talurit system of splicing for wire ropes, which is finding increasing application in various industries, is being demonstrated on this company's stand. These demonstrations will be carried out on a Talurit 25-ton hand-operated press which has a capacity for wire ropes up to ¾ in. circumference.

With the Talurit process, it may be recalled, an aluminium alloy sleeve is employed when a loop or eye, with or without a thimble, is to be made at the end of a rope. The sleeve is passed over the rope, which is then bent to form the loop, and the end again inserted in the sleeve. The assembly is next mounted between swaging dies on the hand-operated press, and pressure is applied to the sleeve so that it is squeezed against the rope. In this way, the metal of the sleeve penetrates between the individual strands and becomes virtually part of the rope, so that a joint of high strength is obtained.

Fig. 1. An Example from the Talurit Range of Safety Slings

In Fig. 1 is shown an example from the new range of Talurit safety slings which are being displayed. A feature of these slings is that the ropes are fitted with rubber sleeves of rectangular cross section, which serve to reduce wear and ensure that a firm grip on the load is obtained. It is stated that the slings are particularly suitable for handling fragile products and loads of irregular shape. Loops at the ends of the ropes are formed by the Talurit splicing process, and multi-rope slings can be supplied with patent shackles, as shown.

Rubber sleeves with metal inserts, known as "Talurit safety pads" are available separately for passing over wire rope slings before loops are formed at the ends. When the sling is in use, the sleeves can be positioned, as required, so that they make contact with the load to be hoisted. In this way an improved grip can be obtained, and the risk of damage to the load and wear on the rope is reduced. These sleeves, which are exhibited, are at present available for use on wire ropes of 1¼, 1¾ and 2 in. circumference.

Salisbury Precision Engineering, Ltd., Buckingham Palace Road, London, S.W.1. Stand No. 98, Ground Floor

A full range of the Sherpa lifting trucks and stackers that are made by this company is on view. The smallest size in the range is a hand-operated hydraulic truck which has a capacity for raising loads up to 2½ cwt. through a maximum distance of 3 ft., and the largest is a new 15-cwt. capacity electro-hydraulic stacker-truck, designated the Sherpa 7, with a maximum lifting height of 10 ft.

Another recently introduced product which is being shown is the Sherpa 6 truck, illustrated in Fig. 2. This truck will raise loads weighing up to 7 cwt., to a maximum height of 5 ft., and is particularly intended for use on rough ground. It may be towed by a vehicle, if desired.

The Sherpa "stair climber" truck, which is also exhibited, is another recent development, and is intended primarily for transporting such products as domestic washing machines up and down flights of stairs. Of tubular steel construction, it is of similar design to a sack truck, but has a pivoted cruciform arm at each side, which is fitted with four rubber-tyred wheels of fairly small diameter. Two wheels at each side support the truck while it is being traversed across a stair tread, and when one of them is brought into contact with a riser, continued movement of the truck caused the arm to swivel. As a result the other wheel is swung clear of the tread and a third wheel makes contact with the next tread. In this way, loads up

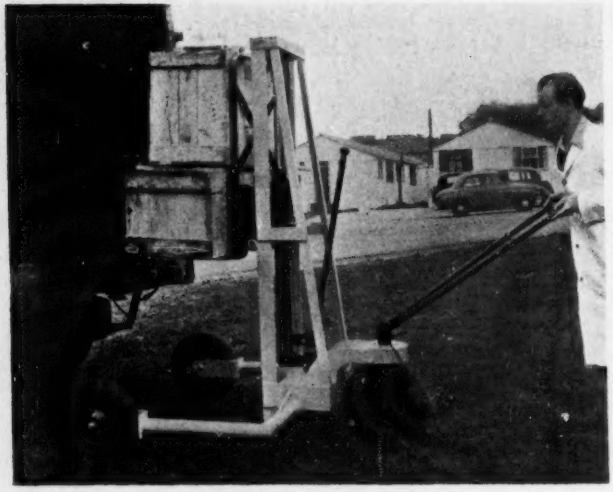


Fig. 2. Sherpa 6 Lifting Truck

to 1½ cwt. can be moved smoothly on stairs by one man.

A ratchet mechanism can be brought into use by means of a lever when the truck is being pulled up stairs, so that it is prevented from running downwards if movement is interrupted. Disengagement of the ratchet causes a brake to be brought into use, and slight effort is then required to move the truck down a flight of stairs.

W. & T. Avery, Ltd., Soho Foundry, Birmingham, 40. Stand No. 291, First Floor

The application of punched-card control to weighing, in connection with automatic production processes, is being demonstrated on this stand, where a hopper scale is being employed for a simple blending operation. Control information is fed to the scale by means of punched cards, and performance data are taken from the scale, for production record purposes, through another punched card machine and a printing, listing, and totalizing punched-tape machine. It is claimed that this system provides a high degree of flexibility, and does not affect the accuracy of the weighing process. For this demonstration, the Avery hopper scale is used in conjunction with a British Tabulating Machine Co., Ltd., card punching machine, a punched-card reader supplied by Power-Samas, Ltd., and a Friden Add-punch machine.

A pneumatically-operated scale, which is also shown in operation on this stand, will automatically tare and fill a succession of containers with a predetermined net weight of material, and is claimed to be particularly suitable for use in areas where flame-proof equipment is specified.

Continuous and accurate weight control of materials fed into a mixer by means of an Avery constant-rate feeder scale is being demonstrated, and an Avery electronic switch is shown applied to a repetition weighing process. For the automatic check-weighing of packages, there is a machine which will handle cartons, ranging in size up to 3 by 2 by 1½ in., at a speed of 40 per min.

Fluidrive Engineering Co., Ltd., Worton Road, Isleworth, Middlesex. Stand No. 268, First Floor

Two new Vulcan-Sinclair traction-type fluid couplings are being exhibited by this company. One of these couplings has a steel casing as shown in Fig. 3, and is particularly intended for use underground in mines, for applications involving rapid acceleration of driving motors under heavy loads. The coupling is short in relation to its capacity, and has low idling drag torque characteristics, so that it can be used to advantage in diesel engine drives.

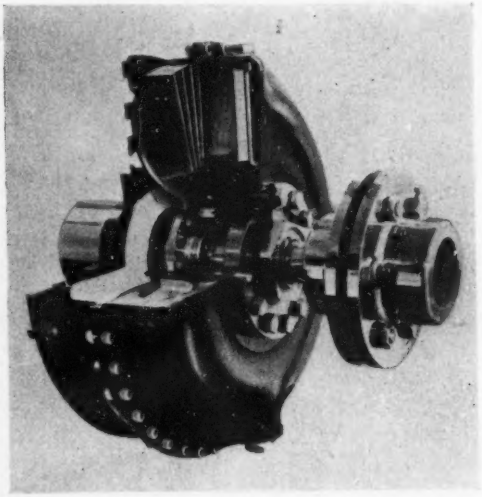


Fig. 3. One of the New Fluidrive Traction-type Fluid Couplings

The second new coupling incorporates a pulley for V-belts, and is intended to be mounted on the shaft of the driving motor. Vulcan-Sinclair fluid couplings of both the traction and scoop types are being demonstrated, and the display includes units which have been sectioned to show the internal arrangement.

Stein Atkinson Vickers Hydraulics, Ltd., Universal House, 60 Buckingham Palace Road, London, S.W.1. Stand No. 242, First Floor

A new power steering unit is being shown on this stand as a working exhibit, in conjunction with a rubber-tyred roadwheel which is in contact with a concrete plinth. This wheel can be pre-loaded on to the plinth, by means of a selector lever mounted on the steering column, so that the unit can be demonstrated under different load conditions.

There is also a comprehensive selection of British-made Vickers-Detroit oil-hydraulic pumps, motors, control valves and cylinders, including a large 2-stage pump, suitable for continuous duty at a pressure of 2,000 lb. per sq. in., and a steering booster suitable for use with medium weight vehicles and forklift trucks. These two items have recently been introduced.

Thos. W. Ward, Ltd., Albion Works, Sheffield. Stand No. 105, Ground Floor

The principal exhibit on this stand is the company's Forward conveyor, which incorporates a digital programme-control system, whereby packages of various sizes and weights can be directed automatically along different routes in a predetermined sequence.

Suitable for handling sand, gravel and chippings, for example, the new transportable bulk piler incorporates an 18-in. wide conveyor belt, which can be driven at a speed of 200 ft. per min. by a petrol or diesel engine or by a geared electric motor. Of tubular steel construction, the frame can be adjusted for angle by a hand-operated hydraulic pump, so that the material which is being handled can be discharged at different heights.

Shown at the Mechanical Handling Exhibition for the first time, are two examples from the Jimmy range of Swedish-made battery-operated electric trucks which the company distributes in this country. Illustrated in Fig. 4, the type RSR fork reach truck is made in three sizes, for raising loads up to 2,200 lb. through maximum distances of 100, 120 and 130 in. The mast assembly has a travel of 129½ in. on the channel-section chassis members for picking-up and discharging loads. The type GS 1000 pedestrian-controlled fork-lift truck, which is also being shown, is available in capacities of 1,100 and 2,200 lb. and with lift heights of 100 and 120 in.

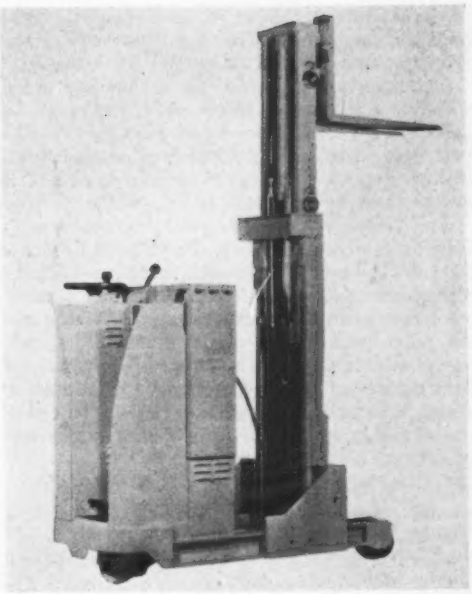


Fig. 4. Jimmy Type RSR Fork Reach Truck

J. Broughton & Sons (Engineers), Ltd., Pershore Road, South, King's Norton Factory Centre, Birmingham, 30. Stand No. 217, First Floor

On this stand may be seen a selection from the firm's range of air cylinders, which are available in sizes from 1½ to 12 in. bore. Diaphragm-type air cylinders from 4½ to 12 in. bore are also on view, together with hand-, foot- and pilot-operated valves, roller- and plunger-operated pilot valves, relay valves, and a recently-introduced air-hydraulic check unit.

Of particular interest is an entirely new type S.M. air-operated gripper feed unit for power presses. Controlled by air valves operated by cams attached to the crankshaft, the unit is available in two designs, one of which is intended for use with press tools fitted with pilots. This unit incorporates a single diaphragm-type air cylinder for gripping the metal strip, the feed movement being effected by a second air cylinder of the piston-type. By adjustment of the cams, the unit can be set so that the strip is released as soon as it is engaged by the pilots. Adjustment can also be made for the next feed movement to be started as

soon as the material has been stripped from the punches, so that the risk of partly-formed blanks, dropping into the die cavities, is obviated.

The other unit, intended for use with press tools without pilots, has a second diaphragm air cylinder which provides for the strip to be held, positively, at the end of the feed stroke, so that slip is prevented during the return travel of the gripper carriage.

The units are made in three sizes which give feed movements from 0 to 1¼, 0 to 2⅝, and from 0 to 8 in., and may be operated at speeds up to 300 strokes per min. With the largest size, the maximum feed movement can be obtained when the press has a ram travel as short at ½ in. and is operated at a speed of 90 strokes per min. The feed stroke can be varied steplessly by means of a screw, which enables precise settings to be quickly made, and it is stated that the pre-set movement is held to an accuracy of ±0·002 in.

Pollard Bearings, Ltd., Ferrybridge, Knottingley, Yorks. Stand No. 312, First Floor

On this stand is shown a selection from the company's Self-Lube range of self-aligning grease-packed ball bearing assemblies, most of which are available for light- and medium-duty applications.

The range includes plummer block and flange-type bearings with single-piece cast iron housings, which are made with bores from ½ to 4 in. diameter. Flange-type units can also be supplied with cartridge bearing assemblies. Flangette bearings on view have pressed metal flanges and are available with bores from ½ to 2 3/16 in. diameter.

Shown in Fig. 5 is a "take-up" bearing assembly, which is intended for use on the shafts of rollers, when adjustment for tension of belts is required. Guide slots are provided at opposite sides of the housing, and an adjusting screw can be fitted at one end.

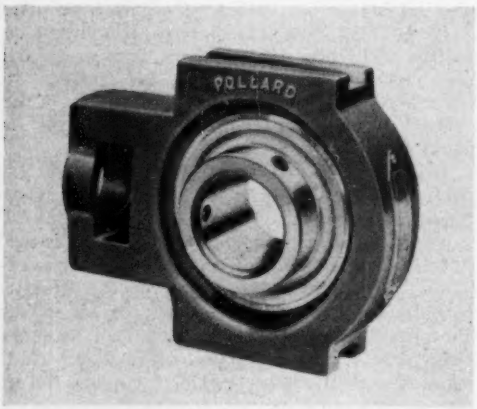


Fig. 5. Pollard Self-Lube "Take Up" Ball Bearing Assembly

Teleflex Products, Ltd., Basildon, Essex. Stand No. 70, Ground Floor

On this stand there is an automatic storage conveyor system, recently developed by the company, for diverting pre-selected numbers of workpieces (which may be partly machined, for example) from one or more overhead chain conveyors to a secondary conveyor circuit for storage. Subsequently, the workpieces can be returned to the main conveyors for transfer to other machining operations.

Although the trolleys which carry the workpieces may be widely spaced on the main conveyor, they can be brought close to each other during storage. The electric control system incorporates a uni-selector multi-contact switch unit of the type employed in automatic telephone exchanges.

Other exhibits include a belt-type conveyor unit, hydraulic lift trucks, examples from the firm's range of overhead cable conveyors, and remote control equipment for a variety of industrial purposes.

Geo. W. King, Ltd., Argyle Works, Stevenage, Herts. Stand No. 43, Ground Floor

The Ski-Wracker light-duty stacking unit being demonstrated on this stand has been developed recently from the company's heavy-duty equipment, and, as may be seen in Fig. 6, it can be employed to advantage for handling fairly large press tools. Incorporating a pair of forks, which can be raised and lowered by a hoist, the equipment is suspended from an overhead gantry, and can be swivelled and traversed in two directions at right angles.

The company's Stanrun conveyor system, which is also shown in operation, is particularly intended for use in machine shops, and has provision for the trolleys to be brought to rest at pre-selected points in readiness for unloading workpieces from the hangers. In this way, a continuous supply of components can be maintained at different machines in a production line. When workpieces from one machine are again loaded on to the hangers upon completion of a machining operation, the trolleys are automatically transferred to the next station in the system.

Reference may also be made to the firm's Dual Duty overhead twin-rail chain conveyor, and the P.C.P. light-duty conveyor, which is designed so that it can readily be installed by the user. Other

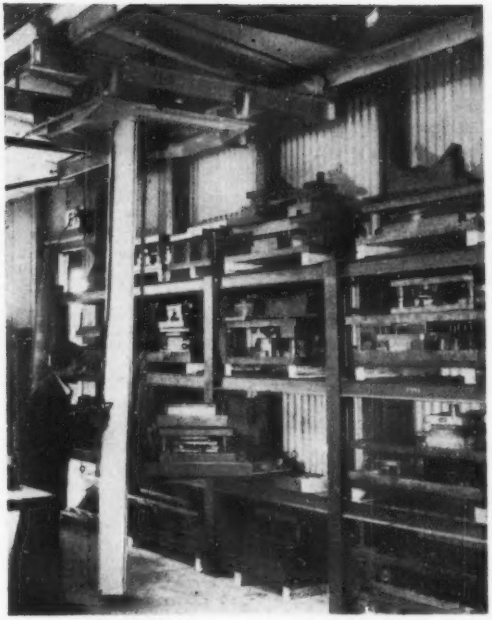


Fig. 6. The New King Ski-Wracker Light-duty Stacking Unit May be Employed for Handling Fairly Large Press Tools as Here Shown

exhibits, all of which are being demonstrated, include the Mammoth, Marvex, Mytemin, and Matem electric, chain pulley blocks, and the Wire Wirker wire-rope hoist.

Igranic Electric Co., Ltd., Bedford. Stand No. 336, First Floor

Four newly-introduced items are shown on this stand, namely, a range of heavy-duty oil-tight control units; block-type contactors; static relays; and a demonstration model of a new magnetic amplifier drive. Features of the range of heavy-duty control units, which comprises push-buttons, selector switches, and indicating lights, are compactness, and the fact that these items can be "stacked," so that a number of different control circuits can be built up. The indicating lights are of the resistor or transformer type, and the design is such that operation of the bulb can be checked without dismantling the unit.

Designed on the unit construction principle, the new block-type contactors cover a range from 10 to 50 amp. capacity, and as many as five main poles may be provided.

Known as the Igrastat, the new type of static control gear shown on this stand is claimed to offer a number of advantages over the electromagnetic type of relay. Owing to the fact that there are no moving parts in this unit, it is stated, no maintenance is necessary, and a total of only four basic plug-in units is required in order to provide a large number of different control circuits. This assembly operates on a very low current rating, and its life is said to be unaffected by the number of operations performed.

The experimental magnetic amplifier drive unit which is being demonstrated is of 5 h.p., and among the applications for which this equipment is intended may be noted speed and tension control, and wire drawing.

Other exhibits on this stand include a mimic flow diagram panel, and a selection from the company's range of standard starters, auxiliary switches, brakes, solenoids, and magnets.

The Plessey Co., Ltd., Vicarage Lane, Ilford, Essex. Stand No. 322, First Floor

A selection from the company's range of hydraulic pumps, valves and single- and double-acting cylinders, which are extensively employed in connection with mechanical handling equipment, is being displayed.

Incorporating patent pressure-loaded bearings, for which high efficiency at working pressures up to 2,500 lb. per sq. in. is claimed, the firm's hydraulic pumps are made in four basic sizes, and with different arrangements of gears and bearings a total of 18 delivery rates from 0·27 to 42 gal. per min. can be obtained. Straight and elbow port adapters can be fitted, which give five different positions for the connection of pipes.

Among the hydraulic control valves on view may

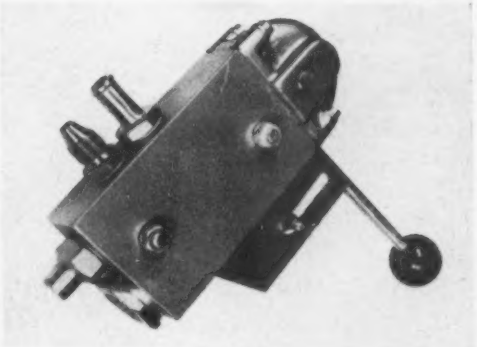


Fig. 7. Plessey Type 10P Hydraulic Poppet Valve

be noted the recently-introduced 10 P poppet type illustrated in Fig. 7, which will handle fluids at delivery rates up to 10 gal. per min. A Plessey flow divider is also being exhibited.

Rawlplug Co., Ltd., Rawlplug House, Cromwell Road, London, S.W.7. Stand No. 289, First Floor

Intended for drilling holes in such materials as concrete, brick and quarry tiles, the new Vibroto portable electric drill, which is being shown by this company, imparts combined percussion and rotary motions to the bit, so that a high rate of penetration is obtained. As was mentioned in MACHINERY 92/742—28/3/58, it will take Rawlplug drills in sizes from No. 6 to No. 20, and has a spindle speed of 940 r.p.m.

By setting a knurled ring on the percussion head, light blows in rapid succession, or heavier blows at longer intervals can be applied to the bit. When the ring is set in a third position, rotary motion only is obtained. A range of special tipped twist drills, with negative rake cutting edges and hardened steel shanks, has been introduced for use only with the Vibroto drill.

Perry Chain Co., Ltd., Stockfield Road, Tyseley, Birmingham, 11. Stand No. 271, First Floor

Attention may be drawn on this stand to the company's new range of "girder section" conveyor chains, which are available with pitches from 3 to 4½ in. Although these chains correspond dimensionally to those for a breaking load of 3,000 lb., they are stated to be capable of taking loads up to 6,000 lb., and have a high resistance to twisting and kinking.

Of heat-treated steel, the side plates are designed so that attachments of various types, for different conveying duties, can be fixed by riveting, without the risk of interfering with driving sprockets. Examples of the chains fitted with attachments of different designs are shown in Fig. 8. The chains are available with 0·475- and 1-in. diameter rollers, and are a zinc-plated bush-type chain.

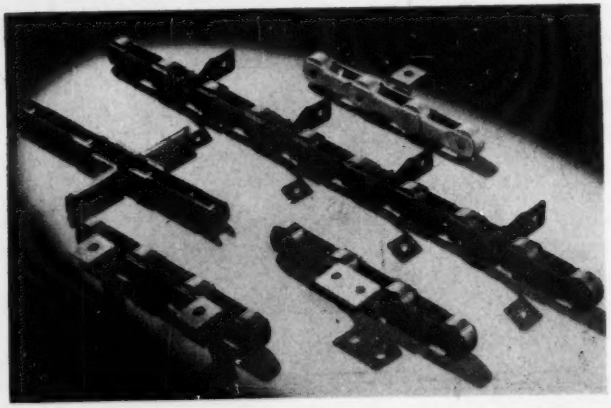


Fig. 8. Some Examples of the Perry "Girder Section" Conveyor Chains Fitted with Attachments of Different Types

Brockhouse Engineering, Ltd., Victoria Works, Hill Top, West Bromwich. Stand No. 295, First Floor

In addition to torque converter components and sub-assemblies of various sizes, and sectional transmissions, this company is showing a complete Davey, Paxman oil-well drilling unit fitted with a torque-converter, a Perkins electrically-driven demonstration unit, and Fordson industrial tractor unit.

These torque-converter units are being employed in fork-lift trucks, also for digging, loading, and earth-moving machinery, and among the advantages claimed are ease of control, elimination of clutch wear, and reduction of driver fatigue.

Geo. Salter & Co., Ltd., High Street, West Bromwich, Staffs. Stand No. 348, First Floor

A display on this stand is designed to emphasize the increased efficiency which can be obtained by the use of Salter crane weighers. These units enable loads of all kinds to be weighed while they are being lifted and moved, and, in standard types, are available in many different capacities, up to a maximum of 100 tons.

Platform weighing machines are included among the exhibits, as are retaining rings and springs for a wide variety of applications. In addition, there is a display of Ahlberg & Aetna bearings, for which this company are the sole selling agents in this country.

CONCRETE MIXING AND HANDLING MACHINERY produced in the United Kingdom during the fourth quarter of last year had an average monthly value of £538,000, and machinery to the average value of £182,000 per month was exported. During the preceding quarter, the average value of concrete mixing and handling machinery produced was £558,000 and machinery to the average value of £170,000 per month was exported. For the first half of the year, the corresponding figures were, £549,500 and £201,500, respectively.

News of the Industry

Bradford

CROFTS (ENGINEERS), LTD., Thornbury, are experiencing a steadily maintained demand for their wide range of power transmission equipment, on both home and export account. Orders are in hand for V-rope and conveyor drives, variable-speed gear units, geared motors, Airflex clutches, gear reduction units, machine-cut gearing, pulleys, friction clutches, couplings, and plummer blocks. A new folder has recently been issued describing the firm's range of electro-magnetic multiple-disc friction clutches and brakes, suitable for wet- or dry-plate duty, and actuated by push-button, limit trip, or automatic relay. The clutches are claimed to be particularly suitable for building into gear-boxes for complex machine tools or transfer plant in semi-automatic factories. A comprehensive range of products is being shown at the Mechanical Handling Exhibition, which is now in progress at Earls Court, London.

CARTER GEARS, LTD., Thornbury, report a good demand for hydraulic steplessly-variable speed gear units, in sizes from ¼ to 35 h.p., including export orders. The field of application of these units is steadily being expanded and we may note that interesting development work is in hand. Following reorganization of the showroom at these works, all types and sizes of units can now be demonstrated under power. Various units are on view at the Mechanical Handling Exhibition.

T. BOWERS & CO. (TOOLMAKERS), LTD., Thornbury, are occupied on a variety of jigs, fixtures, tools, gauges, reamers and special milling cutters, and the associated BOWERS INTERNAL GAUGE CO., LTD., are steadily employed with the production of internal micrometers, counterbore tool sets, and 3-point plug gauges. Recent additions to the internal micrometer range include ½ to ⅝, ⅝ to ¾, and ¾ to 1 in. sizes, also a 9-in. instrument, with either English or Metric graduations. A 2-point adjustable plug gauge has also been introduced, and all these new products will be included in the firm's display at the Gauge and Tool Exhibition, at Olympia.

MOORE MANUFACTURING CO., LTD., Laisterdyke, are well placed for orders, from both home and overseas customers, for their full ranges of drill sleeves and sockets, lathe and grinding machine centres of all types, standard and special milling cutters, and Albrecht drill chucks. The new factory, built for the production of sleeves, sockets and centres, is now in operation, and extensions to the milling cutter factory are in hand. Recent additions to plant include three Dean, Smith & Grace 17-in. swing lathes, Precimax plain and universal cylindrical grinding machines, and an Oerlikon form grinding machine.

STERLING MANUFACTURING CO., are mainly occupied on a variety of sub-contract machining work, comprising turning, milling, and drilling. In addition, we may note recent orders for special independent and self-centring chucks of various sizes.

BENSON VERNIERS, LTD., are busy with home and export orders for vernier calipers, height and depth gauges, gear tooth calipers and beam trammels of various sizes. Recent developments include a new height gauge and a 40-in. reference vernier caliper, which has been introduced in addition to the 80- and 120-in. reference instruments previously made. Other work in progress includes linear and circular scales for application to machine tools. A range of products will be shown at the Gauge and Tool Exhibition. New offices have recently been built at the company's Carlton Works.

HENRY MILNES, LTD., have orders in hand for their standard 13-in. swing lathes, admitting 38- and 72-in. between centres, and for standard vertical milling machines with a table-capacity of 30 by 8½ in. In addition, we may note that a number of the firm's sliding head, elevating-table, heavy-duty fine boring machines is in progress, for which the Rockwell Machine Tool Co., Ltd., Welsh Harp, Edgware Road, London, N.W.2, are the sole selling agents. We understand that considerable interest is being shown in the latter machine, for the boring of hydraulic pump bodies and hydraulic control valves. New plant recently installed includes a Churchill 12- by 50-in. universal grinding machine and a Jones-Shipman hydraulic surface grinder of 24 by 8 in. capacity.

FLEXICON, LTD., are doing a steady home and export trade in belting of various descriptions. V- and round-belts are on order for a variety of industrial applications, also F.S.H.O. belts for the coal-mining industry. Where considerable strength

is required, nylon cores are being incorporated in V-belts, and for fixed-centre miniature V-belts, elastic cores are employed. There is a regular demand for the firm's link V-fasteners for use with V-section belts.

HINDLE AUTO PRODUCTS, LTD., are actively engaged on a variety of gear- and rack-cutting work, and the production of both standard and special gearboxes. The demand on the firm's broaching and splining services is maintained at a good level, and our attention was drawn to a variety of interesting work in progress. Since our last visit, a Dean, Smith & Grace 17-in. swing lathe, with copying equipment, an Orcutt 36-in. spline grinding machine, and a Michigan gear lapping machine with three laps, have been installed.

HENRY LINDSAY, LTD., have supplied details of the Lindivarier variable speed unit, which is being produced in horizontal and vertical enclosed types, in a wide range of standard sizes. Stepless speed variation can be obtained over the full range, without stopping the machine, and the unit, which is fitted with ball bearings throughout, can be run in either direction. This unit is suitable for fixing to the floor, wall, or ceiling.

MERCER PNEUMATIC TOOLS, LTD., in addition to the production of ½-in. capacity motor-driven bench drilling machines, and 9-in. circular bench wood sawing machines, have in hand automatic turret locks and coolant controls for use on Ward and Herbert capstan lathes and B.S.A. automatics. Other activities include the production of various components for pneumatic sanding and hack-sawing equipment, and of the firm's own design of automatic washing machine for use in launderettes.

H. B.

The Midlands

CALUDON ENGINEERING CO., LTD., Brandon Road, Coventry, have a considerable programme of work in progress, including the production of repetition parts and jigs and fixtures for various engineering firms. Equipment installed in the works includes multi- and single-spindle automatics, and a Newall jig-boring machine, which is shortly to be supplemented by another.

HARRY KIRK ENGINEERING, LTD., Brandon Road, Coventry, are now completing their new showrooms, with an area of 2,000 sq. ft., where facilities are available for demonstrating large rebuilt machine tools under power. In this category are included planing machines and horizontal boring machines, with weights up to 40 tons, in which the company specializes. Adequate lifting facilities are available and the design of the buildings is such that heavy loads can be manœuvred. The premises are to be enlarged at a later date, and extra showroom space will then be available. We are informed that there is a good demand for the heavier types of machine tools rebuilt by this company, and that orders have been received from the U.S.A. and other countries, as well as from the home market.

A View in the New Works of Metrosine Tools, Ltd., Walsall

METROSINE TOOLS, LTD., Woodwards Road, Walsall, Staffordshire, are now well established at this address after their removal from premises in Queen Street, Walsall. The new works, built on a growing industrial estate, have been designed to afford optimum conditions for the production of precision gauging equipment and special tools, as will

be evident from the illustration on page 1122.

Over the greater part of the concrete floor of the building, which extends to 7,000 sq. ft., there are embedded electrical heating elements, and current is drawn from the mains at "off-peak" hours. The heat stored in the concrete mass is liberated slowly throughout the day at a rate which is sufficient to maintain a temperature within the works of approximately 68 deg. F. Extensive use of modern insulating materials in the structure of the building, which, it may be noted, has double glazed windows, helps to conserve heat. Acoustic tiles are fitted to reduce noise to an acceptable level. The heat treatment shop is equipped with several new furnaces. F. W. H.

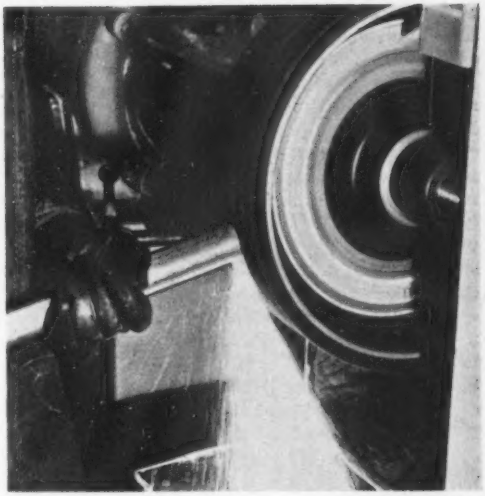
Industrial Textiles Fair

The third Industrial Textiles Trade Fair, organized by Trade Fairs & Promotions, Ltd., Drury House, Russell Street, London, W.C.2, was held recently at the Royal Albert Hall, London. Some 50 firms were represented, and exhibits included fabrics and fabric products in both synthetic and natural fibres, for use in a variety of industries.

A 4-in. wide abrasive belt with a cotton-fabric backing material was included in the collective display of the Cotton Board, Royal Exchange, 6th Floor, Manchester, 2, which occupied five adjacent stands. A product of the Carborundum Co., Ltd., Manchester, 17, the belt had been used to remove metal from one end of a 1-in. diameter mild steel bar at the rate of 1 in. per min., and such a test is shown in progress in the accompanying illustration. After operating under these severe conditions, the belt showed few signs of wear and none of disintegration. This display also included a machine-cut gear of resin-impregnated cotton cloth, and a wide range of protective clothing.

British Nylon Spinners, Ltd., Pontypool, Mon., showed examples of tarpaulins of polyurethane-proofed nylon fabric, conveyor belting, ropes, and tyres for aircraft and earth-moving vehicles. A selection of fabrics for use in the manufacture of hose for oil and petrol, transmission belts, and industrial aprons, was shown by Hay & Robertson, Ltd., P.O. Box 25, Dunfermline, Scotland.

On the Terylene stand of Imperial Chemical Industries, Ltd., Millbank, London, S.W.1, were noted V-belts, electric motors, protective clothing, and fire hose, incorporating this material, while the Leathercloth Division of this company (P.O. Box 15, Hyde, Cheshire), exhibited such products as bellows and fire-resistant suits, of Vynide and Splendex. Flame-resistant clothing was also on



Grinding the End of a 1-in. Diameter Mild Steel Bar on a Carborundum Abrasive Belt with a Cotton Fabric Backing Material

view on the stand of Proban, Ltd., 127 Royal Exchange, Manchester, 2. When Proban-treated fabric is exposed to flame, charring takes place but there is no rapid spread of fire, and when the source of the heat is removed no smouldering occurs. These properties are unaffected by washing and dry cleaning, and it is stated that the finish also provides high resistance to rotting.

Examples from their range of endless driving belts of circular cross section were shown by Luke Turner & Co., Ltd., Deacon Street, Leicester. These belts are intended for light duty at high speeds, and can be supplied in a variety of sizes in braided-rubber and non-stretch types.

Financing Sandwich Courses

Since the White Paper on Technical Education was published in February, 1956, the number of advanced sandwich courses, under which students spend part of the year in a technical college and part in industry, has increased from 100 to more than 200, and the number of students involved, from 2,000-3,000 to 5,000-6,000. The objective is to raise the number of students to 15,000-20,000, and so contribute to the building up of the supply of technologists which the country needs.

With a view to stimulating the spread of these courses, particularly among medium-sized and small firms, the Ministry of Education and the

Federation of British Industries have been reviewing the arrangements for giving financial assistance to students who wish to take them.

The Federation of British Industries, in a policy statement issued recently to all members, has stated its belief that industry, by enabling selected employees to pursue advanced sandwich courses, in addition to supporting day release schemes, acts in its own as well as in the nation's interest. The Federation recommends to its members that firms which already pay their students' fees and salaries should continue to do so, and expresses the hope that firms sending students on advanced sandwich courses in the future will follow this example, since it stimulates the student's sense of loyalty to the firm and strengthens the firm's ties with the college. Such payments are treated as normal business expenses for tax purposes.

The Ministry and the Federation recognize, however, that there are and will continue to be firms who do not feel able to meet the whole cost of such training. There will therefore be a continuing number of such students who will look to local education authorities for aid. In a memorandum also issued recently, Mr. Geoffrey Lloyd, the Minister of Education, has recommended local education authorities to give sympathetic consideration to such applications.

The memorandum indicates the basis on which awards to students taking advanced sandwich courses should be calculated.

Letter to the Editor

[The Editor does not hold himself responsible for the views expressed by his correspondents.]

Precision Forging

(*To the Editor of* MACHINERY)

SIR,—In your leading article on "Precision Forging" in MACHINERY, 92/931—25/4/58, we were particularly interested to read the references to the work done in Germany on the finish-forging of gears on friction screw presses. This matter, which is by no means new, has been the subject of discussions amongst British drop forgers, and was specially referred to at the Technical Convention in November, 1956. The process itself is covered by patents and could only be used by licensing arrangements.

One of the companies we represent in Britain, namely Hasenclever of Dusseldorf, who are among the leading makers of friction screw presses, are in a position to supply such presses for finish-forging gears, as their presses are also used by the German manufacturers in Munich. As far as we know, however, no arrangements have been made or are being made to use the process in this country, although we understand that licensing arrangements were recently made with a well-known firm in France, and that heavy Hasenclever screw presses will be used.

PAUL GRANBY & CO., LTD.,
P. Granby, Managing Director.

Westminster

Tungsten Carbide Gauge Blocks

Broomfield Engineering Co., Ltd., Folly Hall, Huddersfield, are now making sets of gauge blocks

Broomfield 81-piece Set of Tungsten Carbide Gauge Blocks

in tungsten carbide. It is claimed that these blocks have at least 100 times the life of tool steel blocks. Sets of 81 and 27 pieces to both workshop and inspection tolerances are available, and an 81-piece set is shown in the illustration.

Course on Quality Control

The College of Technology, Birmingham, is again offering a full-time course, of three weeks duration, on "Statistical Quality Control and Acceptance Sampling," starting on Monday, September 8. This course is primarily intended as an introduction to the subject, but it provides the basic training necessary for quality control engineers. It will be directed by Dr. C. J. Anson, senior lecturer in the Mathematics Department, and Mr. J. D. Morrison, senior lecturer in the Production Engineering Department.

Further details and application forms can be obtained from the Registrar, College of Technology, Gosta Green, Birmingham, 4.

Personal

MR. C. TREHARNE JONES, B.Sc., A.M.I.Min.E., has been appointed to the board of Dowty Mining Developments, Ltd.

MR. A. J. S. ASTON and MR. R. D. YOUNG have been appointed to the board of Tube Investments, Ltd., The Adelphi, London, W.C.2.

MR. F. MOORE has been appointed deputy chief engineer of Steel, Peech & Tozer, a branch of The United Steel Companies, Ltd., 17 Westbourne Road, Sheffield, 10.

AIR MARSHAL SIR R. OWEN JONES, K.B.E., C.B., A.F.C., R.A.F. ret., B.A., was recently elected to succeed Sir George Nelson, Bart., LL.D., M.I.E.E., as president of the Institution of Mechanical Engineers.

MR. D. BIGNOLD has been appointed Midlands and Eastern Counties technical sales representative for machine tools for Newall Group Sales, Ltd., Peterborough, following the resignation of Mr. A. Nicholl.

MR. S. P. CHAMBERS, C.B., C.I.E., B.Com., M.Sc. (Econ.), of Imperial Chemical Industries, Ltd., has been appointed president of The Combustion Engineering Association, 6 Duke Street, St. James's, London, S.W.1, for the year 1958-59.

MR. ROY DAVIES has been appointed London sales manager of the Tate Machine Tool Co., Ltd., London, W.14. Before joining this firm he was London and Home Counties representative for Modern Machine Tools, Ltd., Smart & Brown, Ltd., and Pultra, Ltd.

MR. W. NUNN has been appointed export sales manager of the Engineers Tool Division of Brayshaw Furnaces & Tools, Ltd., Belle Vue Works, Manchester, 12. Mr. Nunn, who is a native of Sheffield, was formerly on the staff of Joseph Thompson (Sheffield), Ltd., and, for the past 10 years he has served as head of that company's export department.

MR. R. F. D. MILNER was recently appointed managing director of Derby Cables, Ltd. He has been in the cable industry since 1912 and joined the Derby Cable works of Crompton Parkinson, Ltd., in 1946, and became the general manager later in that year. He was made a director of Derby Cables, Ltd., in 1949.

MR. J. B. CLARKSON has been appointed to the board of directors of Clarkson (Engineers), Ltd., Nuneaton. He is the son of Mr. F. H. Clarkson, the managing director. Mr. J. B. Clarkson is expecting to leave shortly for Germany, where he will be joining the subsidiary company, Clarkson G.m.b.H., at Mettmann/Rhld, near Düsseldorf.

Mr. J. B. Clarkson

MR. R. W. STOREY, F.R.S.A., A.I.E.E., F.B.S.C., has been appointed sales manager of Westool, Ltd., St. Helen's Auckland, Co. Durham. Until recently he was general sales manager of Simmonds Aerocessories, Ltd.

Correction

On p. 1065 of this issue of MACHINERY, the stand number of Grey & Rushton (Precision Tools), Ltd., at the Gauge and Tool Exhibition is given incorrectly. This company will occupy Stand No. 156 (Gallery).

Developments in Plastics Tooling

(*Continued from page* 1051)

tools, particularly of large and complex forms, is simplified when the glass fibre backing mixture is employed.

Finally, it should be pointed out that whereas the cost of a tool with metal fibre reinforcement is considerably lower than that of an orthodox all-metal tool, it is necessarily more expensive than a simple resin casting. Despite the advantages which it is claimed to offer, therefore, it is not recommended that this composition should be used for all plastics tools, but only where the service conditions are such as to justify the added complications of tool-making.

Industrial Notes

JACKSON & BRADWELL, LTD., and their associated company, Balancing and Technical Services, are moving, on May 10, to Grove House, Sutton New Road, Birmingham 23. The new telephone number is Erdington 7411/2, and the telegraphic address, Expert Birmingham 23.

AN AUCTION SALE OF MACHINE TOOLS, cranes, and miscellaneous stores, from M.O.S. Sub Depot, Lily Lane, Byley, Middlewich, Cheshire, will be held at New Islington Public Hall, Ancoats, Manchester, on June 3. The auctioneers will be J. H. Norris & Son (Dept. N), 9 Albert Square, Manchester, 2.

EMPLOYMENT IN MANUFACTURING INDUSTRY.—The number of people employed in manufacturing industry fell by 30,000 during February, from 9,284,000 to 9,254,000. There was a decrease of 11,000 in "engineering, metal goods, and precision instruments," of 1,000 in "vehicles," and of 2,000 in "metal manufacture."

MULLARD, LTD., Mullard House, Torrington Place, London, W.C.1, have formed a Semiconductor Division to co-ordinate all the company's product activities in this field. The head of the new Division is Mr. G. A. Gilbert, M.B.E., B.Sc., and it incorporates commercial and technical departments.

WAKEFIELD-DICK INDUSTRIAL OILS, LTD., 67 Grosvenor Street, London, W.1, are now marketing the Wakefield spray unit, type 3493V. This unit was developed for use by British Railways for cleaning the underframes of rolling stock, and it comprises a 9-gal. pressure vessel with facilities for spraying a detergent mixture. It is also suitable for the high pressure application of any similar air/liquid mixture.

LANCASHIRE DYNAMO GROUP SALES, LTD., have opened a new sales and service office at 12 Princes Street, Ipswich (telephone number Ipswich 56141/2), to provide improved facilities for customers of all companies in the Group. The territory covered from this office will include Suffolk, Norfolk, Cambridgeshire, Huntingdonshire and the northern half of Essex. Mr. B. L. Perkins, B.Sc., A.M.I.E.E., has been appointed manager of this office.

PRECISION CHAINS, LTD., Clayton Lane, Manchester, 11, have established a new works for the manufacture of a variety of conveyor chains with breaking loads from 7,000 to 200,000 lb. The chains, which are described in publication No. 51/8, include hollow stud, solid stud, detachable bush, and K-angle types. With the latter, the chain side-bar is integral with the horizontal platform of the K-angle, so that exceptional rigidity is ensured.

THE BRITISH INDUSTRIAL TRUCK ASSOCIATION, York Mansion, 94-98 Petty France, London, S.W.1, has joined with other kindred bodies to present a joint exhibit at the Mechanical Handling Exhibition which is now in progress at Earls Court, London. This exhibit takes the form of an information centre in the main aisle through the centre of the main hall of the exhibition, where visitors who have a special interest in handling problems can receive assistance.

MONOMETER MANUFACTURING CO., LTD., Savoy House, 115-116 Strand, London, W.C.2, announce that they have acquired the drawings and designs of the rotary and end-tilting rotary melting furnaces previously made by Stein & Atkinson. The latter company have decided to cease the manufacture of these furnaces in order to increase their capacity for building other types of furnaces in their extensive range, which includes their special Lip-Axis tilting furnaces.

SELLING IN WORLD MARKETS.—The opening session of the Production Conference, which is to be held in conjunction with the Production Exhibition at Olympia, will take the form of a discussion forum on "Selling in World Markets," at which representatives of the Federation of British Industries, the Board of Trade, and the buying and selling industries will discuss this subject. Members of the audience will be invited to join in the discussion. This session will start at 3.30 p.m. on May 13.

NORTH GLOUCESTERSHIRE INDUSTRIAL EDUCATION COUNCIL, 8 Lansdown Place, Cheltenham, are arranging to issue "news letters" to all schools and industrial organizations in Gloucestershire and to many schools and organizations further afield. In the first letter, which was recently distributed, there is a list of Council members, and particulars of the programme for 1958. Notes are also presented under various headings including: industrial appreciation courses; an industrial career; metallurgical training scheme; European apprentice exchanges; and apprentices associations.

GAUGE AND TOOL PRODUCTION.—Sir Stanley J. Harley, B.Sc., M.I.Mech.E., M.I.Prod.E., deputy president of the Gauge and Tool Makers' Association, Standbrook House, 2-5 Old Bond Street, London, W.1, recently drew attention to the remarkable growth in the output of the industry represented by this Association. In 1935 the annual output was valued at something less than £4,000,000, whereas today it is of the order of £70,000,000. No less striking has been the expansion of the Association which originally comprised 16 firms and now has a membership of more than 360.

BOULTON & PAUL, LTD., Riverside Works, Norwich, have secured an order, valued at £80,000, from the International Steel Co., Evansville, Ind., U.S.A., for a mechanized handling plant for the fabrication of structural steel sections, which will be the first of its kind in the United States. Four other plants are in progress for British firms, and a plant for Canada is scheduled for erection in June. The latest order, which is due for delivery in January, 1959, covers a sawing unit and two drilling units, linked by automatic conveyor systems.

An experimental plant (see MACHINERY, 83/155—24/7/53) was installed in the Riverside Works of Boulton & Paul, Ltd., in 1953, in association with James Archdale & Co., Ltd., who supplied the drilling units, and Clifton & Baird, Ltd., the makers of the sawing machine.

ENGINEERING INDUSTRIES ASSOCIATION NATIONAL CONFERENCE.—The first National Conference of the Engineer-

ing Industries Association will be held at Torquay from June 12 to 14 under the presidency of the Rt. Hon. Lord Davidson, P.C., G.C.V.O., C.B., C.H. The conference will open at the Palace Hotel at 10 a.m. on June 12, and Lord Davidson will give his presidential address, which will be followed by a paper, "World Markets and the Engineer," by John Perry, who, until recently, was export director of Metropolitan-Vickers Electrical Co., Ltd. The proceedings on the second day will begin with an address on "Nuclear Energy Development and Its Meaning to the Engineer," by Dr. J. V. Dunworth, C.B.E., M.A., Ph.D., Atomic Energy Research Establishment, followed by an address on "Taxation Problems," by S. W. Alexander, Editor of the *City Press* and a member of the Council for the Reduction of Taxation. The concluding session will consist of an engineers forum, at which a team of experts will answer questions selected from those submitted by delegates. Further details can be obtained from the Engineering Industries Association, 9 Seymour Street, London, W.1.

Machine Tool Share Market

Stock markets were generally quiet last week, and prices in most sections fluctuated narrowly and without any decided trend. The gilt-edged section, however, finished higher and on a firm note, partly as a result of the good gold and dollar reserve figures for April.

In commercial and industrial markets conditions were mixed, and buying interest was moderate and selective. Early dullness gave place to brighter conditions, but apart from a few firm features, price changes on the week were only moderate.

Among machine tool issues, Broom & Wade advanced 4½d. to 10s. 4½d.; Clarkson (Engineers), Ltd., 1s. 3d. to 12s. 6d.; Craven Bros. (Manchester), 1s. to 7s.; Jones & Shipman, 6d. to 21s. 3d.; Kitchen & Wade, 3d. to 10s.; and Stedall & Co., 2s. 3d. to 6s. 9d. On the other hand, Edgar Allen lost 6d. at 27s. 6d.; British Oxygen, 6d. at 34s.; Coventry Machine Tool, 3d. at 8s. 9d.; Geo. Cohen, 3d. at 11s. 6d.; Newman Industries, 3d. at 2s. 3d.; and Thos. W. Ward, 1s. 3d. at 74s. 4½d.

KAYSER ELLISON & CO., LTD.—Interim dividend 5 per cent (same).

KERRY'S (GT. BRITAIN), LTD.—Dividend 12½ per cent.

STEDALL & CO., LTD.—Final dividend of 12½ per cent, making, with the interim, a total distribution of 17½ per cent.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrong, Stevens & Son, Ltd.	Ord.	5/-	7/10½
Allen (Edgar) & Co., Ltd.	Ord.	£1	27/6
" "	5% Prf.	£1	15/-*
Arnott & Harrison, Ltd.	Ord.	4/-	13/9
Asquith Machine Tools Corp., Ltd.	Ord.	5/-	18/1½
" " "	6% Cum. Prf.	£1	18/6
Birmingham Small Arms Co., Ltd.	Ord.	£1	28/6
" " "	5% Cum. "A" Prf.	£1	15/6xd
" " "	6% Cum. "B" Prf.	£1	17/3xd
" " "	4% 1st Mort. Deb.	Stk.	85/-
British Oxygen Co., Ltd.	Ord.	£1	34/-
" " "	6½% Cum. Prf.	£1	21/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	5/-
Broom & Wade, Ltd.	Ord.	5/-	10/4½
" "	6% Cum. Prf.	£1	17/9
Brown (David) Corporation Ltd.	5½% Cum. Prf.	£1	14/6
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	18/6
Butler Machine Tool Co., Ltd.	Ord.	5/-	6/-
" "	5% Cum. Prf.	£1	13/9
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	13/9
Churchill (Charles) & Co., Ltd.	Ord.	2/-	4/6
" " "	6% Cum. Prf.	£1	25/7½
Churchill Machine Tool Co., Ltd.	Ord.	5/-	19/-xd
" " "	6% Cum. Prf.	£1	18/6xd
Clarkson (Engrs.), Ltd.	Ord.	5/-	12/6
Cohen (George), Son & Co., Ltd.	Ord.	5/-	11/6
" " "	4½% Cum. Prf.	£1	14/6
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	13/3
" " " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/9
Craven Bros. (Manchester), Ltd.	Ord.	5/-	7/-
Elliott (B.) & Co., Ltd.	Ord.	1/-	3/-
" "	4½% Red. Cum. Prf.	£1	13/9
Export Tool & Case Hardening Co., Ltd.	Ord.	2/-	1/3
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	13/-
Greenwood & Batley, Ltd.	Ord.	£1	46/10½
Harper (John) & Co., Ltd.	Ord.	5/-	14/-
" "	4½% Red. Cum Prf.	£1	13/1½
Herbert (Alfred), Ltd.	Ord.	£1	67/6
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	10/3
" "	"B" Ord.	5/-	9/9
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	21/3
" " "	7% Cum. Prf.	5/-	5/-
Kayser, Ellison & Co., Ltd.	Ord.	£1	45/-
" "	6% Cum. Prf.	£1	18/3
Kendall & Gent, Ltd.	Ord.	5/-	7/9
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	6/6
Kitchen & Wade, Ltd.	Ord.	4/-	10/-
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/4½
Massey, B. & S., Ltd.	Ord.	5/-	7/9
Modern Engineering Machine Tools, Ltd.	Ord.	5/-	10/-
Newall Engineering Co., Ltd.	Ord.	2/-	4/6
Newman Industries, Ltd.	Ord.	2/-	2/3
" " "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	4/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	16/6
" " "	5½% Cum. Prf.	£1	24/6
Pratt (F.) & Co., Ltd.	Ord.	5/-	21/3
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	5/3
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	33/-
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	11/10½
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	35/-
" " "	5% Cum. Prf.	£1	15/-
Stedall & Co., Ltd.	Ord.	5/-	6/9
Tap & Die Corporation, Ltd.	Ord.	5/-	7/6
" " "	4½% Deb. 1961-1977	Stk.	82/-
Wadkin, Ltd.	Ord.	10/-	18/9
Ward (Thos. W.), Ltd.	Ord.	£1	74/4½
" "	5% Cum. 1st Prf.	£1	16/-
" "	5% Cum. 2nd Prf.	£1	25/3
Willson Lathes, Ltd.	Ord.	1/-	2/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.

PRICES OF MATERIALS

All prices per ton except where otherwise stated.

Pig-Iron

Foundry and Forge

No. 3, Class 2

Middlesbrough zone	£21 6 0
Birmingham	£20 18 3

Phos. 0·1 to 0·75%

Birmingham	£23 17 0

Scottish Foundry

Grangemouth	£25 3 6

Hæmatite

English No. 1

N.E. and N.W. Coast	£25 6 6
Scotland	£25 13 0
Sheffield	£26 15 0
Birmingham	£27 4 0

Welsh £25 6 6

Steel Products

Medium plates	£45 11 6
Mild steel plates, ordinary*	£42 2 0
Boiler plates*	£44 12 0
†Flat bars 5 in. wide and under } †Round bars under 3 in.	£40 0 6
Billets, rolling quality, soft U.T.	£32 15 6

Phosphor Bronze

Ingots (2B8) (A.I.D.) d/d £240 0 0

Copper

Cash (mean) £179 7 6

Cold rolled and hot rolled sheets 4 ft. by 2 ft. by 10 SWG £243 10 0—£247 15 0

Rods ⅞ in. to 3 in. diam. £265 5 0

Tubes, 1¼ in. bore by 10 SWG, ton lots, per lb. 2s. 6½d.

Wire rod, black, hot-rolled (¼-⅞ in.) English £195 7 6

Zinc

Refined, minimum 98 per cent. purity, current month (mean) £62 8 9

Brass

Tubes, solid drawn, per lb. 1s. 5½d.

Strip 63/37, 6 in. by 10 SWG coils, ton lots £209 5 0—£211 15 0

Rods, ¼-3 in. diam. (59 per cent copper) 1s. 8½d.

Yellow Metal

Condenser plates, per ton £147 0 0

Rods, per lb. 1s. 9½d.

Aluminium

Ingots min. 99·5 per cent Canadian d/d £180 0 0

Lead

Refined, minimum 99·97 per cent purity, current month (mean) £72 16 9

Tinplates

‡U.K. Home trade:

Handmill f.o.t. makers' works	£3 11 8½
Cold reduced, f.o.t. makers' works	£3 7 4½

U.K. Export:

Hot rolled basis, f.o.t. works' port	74s. 0d.—76s. 0d.
Cold reduced basis, f.o.t. works' port	76s. 0d.

Gunmetal

Ingots, 85.5.5.5. ex works* £154 0 0

* N.E. Coast, N. Joint Area, Central Scottish Zone.

† U.T. soft basic.

‡ Official maximum price, after allowing for adjustments for increase in price of tin.

MAKERS' PRICES

Hexagon Steel Bars[1]

Sizes in inches from 1 in. up to 2·21 and 2·41 a/f, ex works 2 ton basis £42 17 0

Free cutting black £47 6 6

Reeled Steel Bars[1]

Single-reeled 1½ in. upwards, f.o.t. works (+ usual extra for sizes) £43 9 6

Free cutting £47 19 0

High-Speed Steel

Black random length bar. All prices basic, per lb., subject to extras.

Molybdenum "66"	5s. 10½d.
Molybdenum "46"	5s. 8½d.
14 per cent tungsten	5s. 9d.
16 per cent tungsten	6s. 1½d.
18 per cent tungsten	6s. 4d.
22 per cent tungsten	7s. 5d.
5 per cent cobalt	9s. 6d.
4·75/5·25 per cent molybdenum + 6·0/6·75 per cent tungsten + 1·75/2·05 per cent vanadium (5-6-2)	6s. 0½d.

Precision-ground, High-speed Free-turning Brass Rod[1]

½-in. dia. ± 0·00025-in. 2-ton lots, per lb. 2s. 2½d.

Grey Iron Rod

Die Cast[2] in random lengths 18 in. to 26 in. rough machined ⅛-in. above listed size. Extra for definite lengths. Discounts for orders over £150.

	Per cwt. net. Mark I	Mark III
¾ or ⅞ in.	245s. 4d.	318s. 10d.
1 or 1⅛ in.	196s. 4d.	251s. 10d.
1¼ to 1½ in.	137s. 10d.	171s. 2d.
1⅝ to 2 in.	106s. 2d.	125s. 11d.
2⅛ to 3¼ in.	91s. 6d.	106s. 4d.
3⅜ to 12 in.	86s. 6d.	99s. 2d.

Continuous Cast

10-ft. lengths, centreless machined 1 to 3-in. dia. + 0·010 to 0·020 in., prices as quoted for die cast bar[3]

6-ft. lengths centreless ground + 0·010 in. Extra for hardenable alloy iron[4] Per cwt. net	¾ or ⅞ in.	245s. 4d.
	1 or 1⅛ in.	196s. 4d.
	1¼ to 1½ in.	137s. 10d.
	1⅝ to 2 in.	106s. 2d.
	2⅛ to 3¼ in.	91s. 6d.

Stellite[5]

Welding Rods plain

¼ in. dia. per lb. 30s. 0d.

Toolbits

¼ in. sq. × 4 in., each 22s 3d.

Precision-ground Mild Steel[1]

1-in. dia. + 0·00025-in. 4-ton lots, per cwt. 121s. 6d.

1 Colvilles, Ltd., Glasgow, and 17 Grosvenor Street, London, W.1. 2 Pratt, Levick & Co., Ltd., Chester. 3 Sheepbridge Alloy Castings, Ltd., Sutton-in-Ashfield. 4 "Flocast," Harold Andrews Sheepbridge, Ltd., Halesowen. 5 Deloro Stellite, Ltd., Highlands Road, Shirley, Solihull.

BASIC PRICES FROM LONDON STOCK[6]

Free Cutting Steel

Bright cold drawn:

(Usaspead) over 1½ to 2 in.	£59 17 6
Lead bearing (Usaled)	£64 4 0
Precision ground, 1⅛ in.	£81 12 6

Bright Drawn

M.S. bars (M.M.C.) over 1½ in. to 2 in.	£55 3 6
Square edge flats (Usaflat)	£72 0 0
M.S. angles (Usaspead)	£99 10 0
Casehardening (EN) (Usacase) over 1½ in. to 2 in.	£63 9 6
M.S. bars (EN3B) (Usamild) over 1½ to 2 in.	£57 3 6
Carbon manganese semi-freecutting case hardening (EN202) (Usaspead 202) over 1½ to 2 in.	£72 19 0
35/45 ton tensile (EN6) (Usen) over 1 to 1½ in.	£64 17 6
0·4 Carbon Normalised (Usaspead "40") over 1½ in. to 2 in.	£66 19 6
Carbon manganese steel to Specification EN.16.T (Usaspead 5565), per ton	£127 11 3

Ground Flat Stock

18-, 24-, and 36-in. lengths (Usaspead). List prices less 5 per cent

Oil Hardening Cast Steel

Non-shrink (Usaspead N.S.O.H.) ½ in. to 2½ in., per lb.	1s. 11d.
Non-distorting heavy duty (Usaspead H.C.H.C.) ½-in. to 2½-in., per lb.	4s. 2d.

Silver Steel

(0·194-in. to 1½-in.)

Genuine Stubs quality, per lb. 4s. 6d. less 27½%

M.M.C. quality, per lb. 2s. 5d. + 6½%

Boxes of 16 assorted sizes ⅛-in. to ½-in. dia. 7s. 6d.

Stainless Steel

K.E. 40.AM (Freecutting), per lb. 3s. 3½d.

Glacier Machined Bronze Bars

Phosphor bronze (2B8) } Lead bronze } Prices on application

High-speed Steel

18 per cent tungsten. Prices on application.

Toolholder bits:

Usaspead "Super" } "Supreme" } Cobalt 10 } List price

Shimstock

Steel assorted, per tin	3s. 6d.
Brass " "	7s. 3d.

6 Macready's Metal Co., Ltd., Pentonville Road, N.1. Subject to confirmation by London Office. Delivered free by van in London area.